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# THE PHILIPPINE JOURNAL OF SCIENCE

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No. 1

## GENERA HYMENOPHYLLACEARUM<sup>1</sup>

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ELEVEN PLATES AND ONE TEXT FIGURE

Whoever devotes long and careful study to a group of plants becomes acquainted with their several significant characteristics and recognizes minor groups. He recognizes the groups of individuals as species, and is usually disposed to regard the definable groups of species as genera. Thus the men who have studied the Hymenophyllaceæ most comprehensively, Presl and van den Bosch, have felt constrained to recognize many genera. Prantl recognized a smaller number of genera, chiefly because he knew a smaller range of species. Hooker and Sadebeck, who cataloged very many species, the former in *Species Filicum* and *Synopsis Filicum*, the latter in the *Pflanzenfamilien*, and who went back to the genus concepts of Swartz, are not exceptions to this rule, because, however many species they may have seen, they did not devote to them the careful and detailed attention necessary to an understanding of significant characteristics and of the affinities which these peculiarities make plain.

I began the detailed study of these ferns without suspecting that it would result in dissatisfaction with the general view that

<sup>1</sup> This paper expresses the general results of intermittent studies carried on since 1908, and for a considerable part of my time since 1922. It has been composed in the Herbarium of the University of California, for the use of the facilities of which I gladly express my sense of obligation. I am indebted to Doctor Maxon for many items of counsel and material assistance, and to Mr. C. V. Morton for a very careful criticism of my manuscript; without committing these gentlemen to my conclusions, I thank them for their help.



without end, I have abstained from the publication of ideas on genera, until my familiarity with the species is as complete as it seems likely to become. Here, I would again follow van den Bosch,<sup>4</sup> quoting Fries: "Vana sunt nova genera, sine universali specierum cognitione et praecipue morphoscos historia."

Because I have discussed elsewhere<sup>5</sup> in some detail the two principles which must determine the recognition of genera, this phase of an introductory discourse may be treated briefly here. These are:

*Naturalness*.—A genus must be a natural group. Like a family of men, it must consist of "blood relatives", including all within some accepted measure of affinity, and only these. Such a genus is literally, not figuratively, natural; it exists in nature. Two species of diverse descent (beyond the accepted measure of affinity) do not belong in one genus, though their resemblance may reach apparent identity. In our verbal definitions of genera we use words describing their (usually visible) characteristics; but no such characteristic is fit to serve always as a generic criterion. Phyletic unity, so far as all our evidence lets us recognize it, is the sole categorical test of a genus. Literally speaking, the descendants of a given plant of a century ago are a natural group. The descendants of a plant of a million years ago are a natural group, perhaps, however, represented by several of our species. So also are the descendants of a plant of fifty million or more years ago.

If we knew the genealogies of our plants for these periods, the sole criterion in determining how far back we should go for the common ancestor of a genus would be the other principle:

*Convenience*.—Subject always to the preceding principle (naturalness), a genus should be delimited with all possible regard to our convenience. In its application, this principle develops several aspects. In the first place, it serves our convenience to establish genera which we can recognize easily by their verbal definitions. Again, it may be convenient to have our genera recognizable by a group of common characters, rather than by some one arbitrary criterion;<sup>6</sup> that is, the natural-

<sup>4</sup>Synopsis (1859) 6.

<sup>5</sup>The Oriental Genera of Polypodiaceae. Univ. Calif. Publ. Bot. 16 (1929) 45-128.

<sup>6</sup>This may be disputed; but I believe that our comfortable acceptance of genera recognized by arbitrarily chosen criteria is the result of adjustment, by usage, to a procedure which would be uncomfortable without the adjustment.

ness of a genus should be reasonably recognizable. In other cases, it surely serves our convenience to distinguish as genera groups with few or single conspicuous characteristics. Again, very large genera are inconvenient. *Trichomanes* and *Hymenophyllum* have become inconveniently large genera. "But convenience will not justify us in dividing a genus of a thousand species along any except natural lines; nor let us maintain a genus of two species, unless they are nearly related."<sup>7</sup>

After the removal of several foreign elements *Trichomanes* of Linnaeus remained a natural genus. It would be equally natural still, but would be very inconvenient, comprising the whole family. When Sir James Smith removed one species and set up *Hymenophyllum*, the result was two natural genera. However, with time, the two have not merely outgrown convenience, but they also have not remained convenient in other respects, nor even natural. That they have not remained convenient is attested by the number of species that have been referred to both *Trichomanes* and *Hymenophyllum*, because they share their formal articles of definition—consider *Didymoglossum*, *Meringium*, *Serpyllopsis*. That in recent time they are not natural, is illustrated best by *Sphaerocionium* and *Microtrichomanes*, together forming a natural group and reasonably forming a genus, but with the former treated as *Hymenophyllum*, the latter as *Trichomanes*.

As to the extent to which convenience is served by the recognition of more and more genera, workers cannot be expected to agree. The convenience of the man who wants merely to find names for his specimens, by the most superficial examination which will satisfy this purpose, is not that of the man who seeks to understand the phylogeny of the groups, by the most careful study of each species. The treatment which serves my convenience has changed essentially with the years of study. I find satisfaction in the fact that most of the genera I recognize are those long since set up or maintained by Presl and van den Bosch. Presl must have had a rather remarkable eye for genera. His diagnostic characters might range from imaginary to fantastic—consider *Cephalomanes*, *Pleuromanens*, and *Abrodictyum*; but each of these represents a natural genus. As to the number of genera, Presl and I are not far apart. Presl named twenty-nine genera, some of them almost undefined. Van den Bosch described twenty-four. Including two monotypic ge-

<sup>7</sup> Copeland, op. cit., p. 18.



nera and one of two species which they never saw, I recognize thirty-three.

The genera herein maintained or established are those which seem to me to merit recognition, after test by the two principles already presented. The family is diversified beyond the suspicion of those who have not given it particular study. The characteristics involved in this diversification are useful as generic characters whenever, in the evolution of the family, they have become fixed as attributes of natural groups conveniently to be treated as genera. The most careful study of these characteristics was that of Mettenius. Remembering always that naturalness is the indispensable criterion of a genus, and that characteristics are of systematic utility only as they serve to enable us to recognize natural groups,<sup>8</sup> some general discussion of the characters which are, or might be, useful in this family is in order.

The family as a whole is characterized by peculiarities: (a) Of the gametophyte, (b) of the reproductive structures of the sporophyte, (c) of the vegetative structures of the sporophyte.

The spores, so far as known, are uniform throughout the family. They are of the tetrahedral type, with three originally plane surfaces where they were in contact in the spore mother cell, and a convex face. The plane faces become convex, and the angle where they meet becomes inconspicuous. They contain chlorophyll, and commonly germinate very promptly. Most of our information as to the germination of the spores of different genera and species is due to the presence of young gametophytes in the sori of herbarium specimens. It has been assumed that their period of viability after dispersal is brief; but this is relative, and the assumption should be used very cautiously, in drawing conclusions against the possibility of their dissemination over stretches of ocean. The fact that they have so spread outweighs any antecedent improbability of their doing so.

Beginning with the germination of the spores, the gametophytes are known for so few species that it is unsafe to draw general conclusions. In the majority of observed cases the entire cell (spore) divides into three approximately equal cells; this occurs in *Trichomanes crispum*, *T. (Cardiomanes) reni-*

<sup>8</sup>De natuur kent geene karakters; zij brengt typen voort, wier wezen wij te erkennen en wier verwantschap wij te beoordeelen hebben naar het geheel harer bewerktuiging, zichtbaar in hetgeen wij habitus noemen.—van den Bosch, *Eerste Bijdrage* (1861) 303.

forme, *T. (Microtrichomanes) digitatum*, *H. (Mecodium) abruptum*, *H. (Mecodium) polyanthos*, *H. (Meringium) bixatuc*, *H. tunbridgense*, *H. (Mecodium) capillaceum*, *H. (Meringium) fusceiforme*,<sup>9</sup> *H. (Mecodium) undulatum* (Hedwig, cited by Mettenius), *H. (Mecodium) rarum* (Sadebeck), *H. (Mecodium) dilatatum*, *T. (Microtrichomanes) palmatifidum*,<sup>10</sup> and *T. (Vandenboschia) draytonianum*.<sup>11</sup> In other cases three cells are cut off at the "corners" of the spore, leaving a larger central cell; this occurs in *T. (Vandenboschia) schmidianum* (Taschner), *T. (Crepidopteris) humile*, *T. (Vandenboschia) pyxidiferum* (Mettenius), and *T. (Gonocormus) diffusum* (Goebel).

The further development is known for still fewer species. As generalizations, in "*Hymenophyllum*" one of the three original outgrowths develops, after forming a short protonema, into a thalloid structure, one cell thick except along a narrow axis, bearing archegonia in clusters on cushions near the margin, and antheridia in various places. The species observed belong to *Hymenophyllum* and *Sphacrocionium*. *Cardiomanes* behaves in the same manner (Holloway); and so, I believe, does *Scrupylopsis*. In "*Trichomanes*" the protonema forms an extensively branched structure, ultimately producing thalloid structures which bear the archegonia on short special branches in *T. alatum* (Bower) and *T. sinuosum* (Goebel), or, without thallus, bearing such branches on the branched filament, in *T. (Vandenboschia) pyxidiferum*, *T. (Gonocormus) diffusum*, *T. (Selenodesmium) rigidum*, and *T. (Macroglena) strictum*. Holloway describes the gametophyte of *T. (Selenodesmium) elongatum*, which "has but a brief filamentous stage, and develops into a large strap-shaped tissue body whose meristem is situated at the base of a sinus at its forward end, the archegonia being borne on a series of cushionlike thickenings behind the meristem,"<sup>12</sup> whence it appears that this structure varies within *Selenodesmium*. There are a number of observations of other peculiarities. Mettenius reported exceedingly slow growth of the gametophyte of *T. pyxidiferum*; and there are other observations to the same effect. It seems to be of indefinitely long life, and in both known forms to be capable of vegetative multiplication by the dying off of old parts and independent survival of the branches. Infection

<sup>9</sup> Mettenius, *Hymen.* (1864) 489-491, pl. 4.

<sup>10</sup> Goebel, *Organographie* 2 (1930) 1089.

<sup>11</sup> Campbell, *Mosses and Ferns* (1905) 373.

<sup>12</sup> Holloway, *Trans. N. Zeal. Inst.* (1928).

of the rhizoids by fungi has been observed for several species. A remarkable pitting of the walls is reported for one. The formation of gemmæ seems to be general, and they are of at least two types. Both apogamy and apospory are reported. Goebel reports countless lateral antheridiophore outgrowths from the ribbonlike thallus of *T. (Didymoglossum) Kraussii*.

The paucity of these observations, and their indiscriminate distribution among the genera I recognize, makes it impossible at this time to use gametophytic characters for the characterization of the genera. With regard to the Polypodiaceæ our information is more extensive, and, aside from the Vittariææ, there is such uniformity that the gametophyte is valueless in taxonomy. Among the Hymenophyllaceæ so much diversity is known that more complete information seems likely to make the gametophyte very useful in an understanding of the evolution and in the correct classification of the group.

The division of the family into two genera has been based on the form of the involucre (indusium), supposed then to be composed of two mutually free "valves" in *Hymenophyllum*, and to be a tube in *Trichomanes*. The condition ascribed to *Hymenophyllum* s. lat. exists in many species of *Hymenophyllum* s. str., *Sphaerocionium*, and *Mecodium*. Since the involucre begins at the base of the receptacle, the valves are not free unless the whole sorus protrudes beyond the margin. It is usually more or less immersed, in which case there is at least the beginning of a tube. It is wholly immersed in *H. (Sphaerocionium) Lyallii*, leaving no free lips, so the species is moved to *Trichomanes*; *T. (Apteropteris) Malingii*, equally without free valves, was moved in the other direction. Even if the sorus is not immersed, there is a tubular or obconic base in very many species called *Hymenophyllum*—Presl's *Meringium*, *Leptocionium*, and others. Conversely, two groups of "*Trichomanes*," *Crepidomanes* and *Didymoglossum*, have the mouth of the involucre divided into two lips, more deeply so in some species of *Crepidomanes* than in some species of *Meringium*. To provide for these very many species that do not conform to the definition of either genus, Presl and van den Bosch, who recognized many genera, set up intermediate groups of genera, *Sectio Didymoglossæ* Presl, and *Tribus Leptocioneæ* van den Bosch.

At the base of the sorus the fertile vein may give rise to a branch running up each side of the tube; this phenomenon is observed in some but not in all species of *Mecodium*, *Meringium*,

and *Vandenboschia*. The tube is more than one layer of cells thick in *Trichomanes* s. str. but not in all groups of *Trichomanes* s. lat.; this difference merits detailed study.

The receptacle is typically included—that is, not longer than the involucre—in "*Hymenophyllum*," of indefinite length, by basal intercalary growth, in *Trichomanes*. In *Trichomanes* s. lat. there is uniformity of type, the globose tip and the inflated base on which respectively Presl based his genera *Cephalomanes* and *Itagatulus* being illusory. The receptacle of *Meringium* and its derivatives and of *Leptocionium* is like that of *Trichomanes*, indefinitely long. That of *Hymenophyllum* s. str. is of the same type but of limited growth, not typically exceeding the involucre. In *Mecodium* and *Sphaerocionium*, growth ceases by the time the sporangia develop, the latter being simultaneous.—*Simplicies*, of Bower. In each of these genera there are natural groups of species with cylindrical receptacles, and others with more or less globose receptacles, all having longer or shorter sterile bases. These are illustrated for very many *Mecodium* species in my *Hymenophyllum*.<sup>12</sup> I place in *Mecodium* some American species with extruded receptacle. The sporangia may be sessile on the body of the receptacle, or may be borne on more or less prominent outgrowths, sporangiophores. Some species produce basal paraphyses.

The sporangia are uniform in type, sessile, with an obliquely transverse annulus interrupted by the stomium. In general they are large, with many superficial cells and up to 256 or 512 potential spores in *Hymenophyllum* s. lat.; small, with few superficial cells and comparatively few spores, in *Trichomanes* s. lat. Bower has studied these most amply, and concludes that species producing very numerous sporangia produce correspondingly small ones. However, *Cardiomanes* bears very long receptacles with indefinitely many sporangia as large as are known in any leptosporangiate fern.

In the range of modifications in vegetative form and structure in adaptation to a generally humid environment, the *Hymenophyllaceae* exceed any other family in the plant kingdom. This statement may astound those accustomed to the summary dictum that these are plants of very simple structure, but I make it with confidence. In a humid environment transpiration is limited. The leaf structure, evolved in perfect adaptation to the environment, then demands that the transpiration be lim-

<sup>12</sup> Philip. Journ. Sci. 64 (1927) 1.

ited, and the group is incapable of adaptation to constantly dry environment. In the internal economy of such plants the typical stem plays a minor part. It is a creeping rhizome bearing remote distichous fronds in most genera; this is the primitive stem of the family. In *Trichomanes* s. str., *Selenodesmium*, *Davalliopsis*, *Nesopteris*, *Callistopteris*, and *Cephalomanes*, it shortens and is ascending or erect, with congested polystichous fronds. The bundle is of the concentric fern type. When, in stem or leaf, it becomes collateral, it does so by reduction, and these collateral bundles are not homologous with those of other plants.

Root bundles are usually diarch, but range from monarch to monarch. The most remarkable phenomenon as to the roots of the family is their disappearance. Mettenius found them absent in *T. (Vandenboschia) pyxidiferum* and *schmidianum*, *T. (Gonocormus) saxifragoides*, *T. (Crepidomanes) intramarginale*, *latemarginale*, and others, *T. (Microgonium) cuspidatum* and others, *T. (Didymoglossum) Petersii* and others, *T. (Lecanium) membranaceum*, and *T. (Crepidopteris) humile*. The number of species usually rootless is very large, but a root can occasionally be detected on species normally rootless. Rootlessness in general seems to characterize all of the genera just named in parentheses, with the exception of *Vandenboschia*.

In the absence of roots, stems take their place. These metamorphosed stems may be long, slender, freely branched, with suppression of the leaves. In substitution for root hairs, they produce rhizoides, cut off by a septum at the base. *Hymenophyllum (Mecodium) axillare* produces similar metamorphosed leafless stems, except that they bear roots. Besides the ordinary functions of absorbing liquid and anchoring the plant, the stout roots of old plants of *Trichomanes* s. str., *Cephalomanes*, and *Selenodesmium* serve as braces or props, to hold up the erect stems, which are not directly fixed in the ground.

The leaves vary from entire to flabellate, many times dichotomous, and as many as five times pinnatifid. *Cardiomanes* and *Hymenoglossum* have simple fronds of considerable size; those of *Didymoglossum*, *Microgonium*, and *Craspedophyllum* are very small, even down to 5 mm or less long. The minute fronds of *Microgonium* and *Didymoglossum* are flat, not circinate, in vernation, unlike those of any other leptosporangiate ferns. Fronds up to several decimeters long are erect, in the genera with erect stems, or pendant in *Sphaerocionium*, *Mecodium*, and *Vandenboschia*. The systems of branching in the axes of

the fronds are of the same types as in other ferns. Really reticulate venation occurs only in certain species of *Trichomanes*. A marginal vein connects the ends of the veins in most species of *Microgonium*. Besides veins with the usual structure, "false veins" occur. These are placed like veins, and may represent reduced or aborted veins, in *Trichomanes* s. str. spp., *Didymoglossum*, *Lecanium*, and in part in *Microgonium*; or they are structures *sui generis* in no way related to real veins, in *Crepidomanes* and in part in *Microgonium*. These are sometimes distinguished as striæ. There are also marginal structures, presumably protective, loosely spoken of as false veins, characteristic of *Pleuromanes*, *Crepidopteris*, *Craspedophyllum*, and *Hymenoglossum*. The elements of the striæ of *Crepidomanes* are like those surrounding the axes and forming sclerenchymatous sheaths. They are silicified, and in structure are peculiar to the family; Mettenius named them "Deckzellen," 'lapetal cells.'

The family is commonly defined as having the lamina a single cell thick. This is true in general, and precludes the differentiation of the tissues and tissue systems characteristic of other vascular plants. *Cardiomanes* and *Davalliopsis* have leaves uniformly three, four, or five cells thick, as do also *H. (Mecodium) dilatatum* and *scabrum*. In these cases the superficial cells are essentially like those of the family in general, and the differentiation of the internal cells does not extend beyond some difference in size, and the absence of chlorophyll. There are no intercellular spaces. I do not regard these thick leaves as primitive, but agree with Goebel that they are "tertiary" modifications. Fairly conclusive ontogenetic evidence to this effect is presented by Holloway.<sup>14</sup> The colorless internal cells, without intercellular spaces, would surely not be expected in an intermediate evolutionary stage between the leaf of any ordinary fern and that of *Hymenophyllum*. There are a considerable number of known cases of fronds partly two cells thick. This discussion applies only to the parenchymalike cells; striæ and specialized margins are commonly two or more cells thick.

There are remarkably specialized cell walls, which sometimes serve to characterize genera. Remarkable coarse-bordered pits of essentially the same general design are found in *Selenodesmium* and *Meringium*, with exceptions that may be primitive

<sup>14</sup>Trans. N. Z. Inst. 54 (1923) 587.

in New Zealand but are almost surely tertiary in Malaya. Similar walls occur in some species of *Macroglena*. The most remarkable plant in the family, in the structure of its walls and the form and arrangement of its cells, is *Abrodictyum*.

As to the cell contents, van den Bosch has described them in general terms for a great number of species, but his data have not been found available for the characterization of groups. *Sphaerocionium*, so far as the species have been tested, is remarkable for very small and numerous chromatophores. Remarkably large cells characterize *T.* (*Vandenboschia*) *philippianum* and most species of *Macroglena*; those of *Cephalomanes* also are large.

This is not an exhaustive list of the morphological peculiarities exhibited by members of the family, still less of the groups and species which demonstrate them. Most of our information up to date is the work of Mettenius, comparatively little having been added by Prantl, Giesenhagen, Boodle, Bower, Campbell, and other successors—somewhat more by Goebel.

One of the most unique such features shown by any genus is the loss of distinction between rhizome and stipe in *Gonocormus*. With this exception, proliferation by the frond is rare in the family, confined to *Trichomanes* s. str. and its derived genus *Foca*.

The trichomes of the family merit a separate paragraph, having a taxonomic value which has been too little appreciated. Hairs of one, two, or more cells protecting the apices of stems and very young leaves are general in the family and are usually caducous. They may seem to be attached above the base, and in this case have been called paleae. Club-shaped bicellular hairs are more persistent in *Nesopteris*, and fringe the mouth of the involucre of two species. Long, soft hairs are common enough to be characteristic of *Trichomanes* s. str. and *Meringium*. In *Pleuromanes* they are borne on the broad axial pad, but not on the unilaminate "parenchyma." Large, stalked, stellate trichomes characterize *Sphaerocionium*, and their modifications are characteristic of the minor groups of that genus. Their stalk cells may disappear, leaving a sessile, stellate cluster of setae. By further reduction these setae become paired, and finally single. Such setae persist on some, not all, species of the derived genus *Microtrichomanes*. They occur also on *Didymoglossum*, but not on *Microgonium*, whether or not the latter has a marginal vein.

Real palae, superficially expanded trichomes, such as characterize the *Cyathea-Dryopteris*, *Matonia-Polypodium*, and *Oleandra-Davallia* phyla of Polypodiaceae, are unknown in Hymenophyllaceae. The structures so construed in *H. (Bucsia) mirificum* are mostly cut-off fragments of the common wing of the axis, as was recognized by Presl in the case of *H. (Ptychophyllum) plicatum*.<sup>15</sup> "Stipes bifarie palaeaceus vel potius margine frondis utriusque in dentes acuminatos palaeae formibus dissoluto instructus." One New Guinea species of the *Meringium* group, with much-cripsed (overfull, plicate) lamina, has the whole of the wing of the frond broken up in this manner. It is thus destitute of any venulate green laminar area, a condition so remarkable that I have tried to give it adequate emphasis by constituting it a genus (*Myriadon*), although its relation to *Meringium* is perfectly clear. There is a better known and repeatedly illustrated derivative of *Sphaerocionium*, whose photosynthetic area consists of innumerable short filaments standing out in all directions from the axes; this also is worthily treated as a genus (*Apteropteris*).

While adaptation to a humid environment is the general principle in the evolution of this family, the fact is not to be overlooked that a large part of them are epiphytes, and that epiphytes in general are of necessity able to endure temporary dryness. Polypodiaceous epiphytes, as a generality, are structurally equipped to retain water during temporary outside dryness, but such structural equipment is comparatively rare in Hymenophyllaceae. The colorless internal cells of *Cephalomanes reniforme*, *H. dilatatum*, and *H. scabrum* seem to serve for water storage. The hairy covering of many species of *Sphaerocionium* is a protection against loss of water. *H. (Apteropteris) Malinonii* is the one plant in the family structurally apparently highly modified to live as an exposed epiphyte. As Giesenhagen emphasized, there are devices of form by which liquid water is conserved outside the leaf.

Most commonly, as I pointed out long ago, the epiphytes of this family are fitted to their environment by enduring the loss of water, as do the mosses, and still more perfectly the lichens. In my experience most species change their form during desiccation, but Holloway<sup>16</sup> reports that *H. rarum* and *H. flabellatum*, and even the prothalli of the former, remain unchanged while

<sup>15</sup> Hymenophyllaceae (1843) 121.

<sup>16</sup> Trans. N. Z. Inst. 54 (1922) 591.



the moss they grow in curls up with dryness. Shreve<sup>12</sup> has reported concentration of the cell sap amounting to nearly or quite half-normal salt.

The bad state of the nomenclature of these plants has been remarked upon repeatedly, sometimes by those who contributed to the evil. Thus Prantl<sup>13</sup> could note "die in einem heillosen Zustande befindliche Synonymik," but deliberately reject *Feca* and *Cephalomanes* in favor of later names. Giesenhagen described the taxonomy of a part of the family as "eine ausserordentliche Verwirrung," and "ein wirres Durcheinander."

I have tried to bring order into the generic nomenclature by a scrupulous observance of the accepted rules, the essential principle of which is that any group now treated as a genus must bear the oldest tenable generic name of any species now included in it. Such a species is the type species of the genus, and the generic name cannot be dissociated from it. This rule is exceptionally easy to apply in this family because the older and larger genera were mostly described originally, each with a single species, leaving no chance for difference of opinion as to the type.

The generic names proposed for these plants are shown in chronological order, by the following enumeration. For convenience I include, but indent, the names imperfectly proposed for genera, or proposed for groups of infragenetic rank. The type species is given in each case. The genera retained are in boldface type.

**Trichomanes** Lianxus (1737). *T. crispum*.

*Pyxidaria* Gleditsch (1764). (This name has no status at all.)

*Achomanes* Necker (1790) = *Trichomanes*.

*Hymenophyllum* Smith (1793). *H. timbridgense*.

*Ptychomanes* Hedwig (1800) = *Hymenophyllum*.

*Feca* Bory (1824). *F. nana* Bory = *F. botryoides* (Kaulf.) v. d. B.

*Hymenostichys* Bory (1824). *H. elegans* (Rudge) = *Trichomanes diversifrons* (= *Feca*).

*Didymoglossum* Desvaux (1827). *D. muscoides* Desv. (= *Trichomanes hymenoides*).

*Lecanium* Presl (1843). *L. membranaceum* (L.) Presl.

*Cardiomanes* Presl (1843). *C. reniforme* (Forster) Presl.

*Achomanes* Presl (1843) = *Trichomanes*.

*Eutrichomanes* Presl (1843). Included spp. of *Didymoglossum*, *Sphaeroclonium*, *Gonucormus*, *Crepidomanes*, and many others, but not *Trichomanes crispum*.

<sup>12</sup> Bot. Gaz. 51 (1911) 204.

<sup>13</sup> Hymenophyllaceae (1875) 53.



- Lacostea* van den Bosch (1861); Prantl (1875). *Trichomanes Ankerii* = *Trichomanes*.
- Marckeliosorus* van den Bosch (1861). *M. Mougeotii* v. d. B. = *Feca osmundoides*.
- Phlebtophyllum* van den Bosch (1861), non *Phlebophyllum* Nees (1832). *Trichomanes venosum* = *Polyphlebium*.
- Ptilophyllum* van den Bosch (1861); Prantl (1875) non *altiorum* prior. = *Trichomanes*.
- Pachyloma* van den Bosch (1861), non D. C. (1828). *Hymenophyllum marginatum* = *Craspedophyllum*.
- Trigonophyllum* Prantl (1875). *Ptilophyllum Bancroftii* = *Trichomanes arbuscula*.
- Acarpaciurn* Prantl (1875). *Ptilophyllum ptilodes* = *Trichomanes alatum*.
- Leptomanes* Prantl (1875). *Trichomanes tenax* Spr. = *Vandeboschia*.
- Lacostopsis* Prantl (1875). *Trichomanes "radicans Sw."* = *T. repens* (?).
- Sclenadesmium* Prantl (1875). *Trichomanes rigidum*.
- Helophlebium* Christ (1897).
- Hemicyathea* Domin (1913). *Hymenophyllum Baileyannum*.
- Acanthotheca* Nakai (1926), non D. C. (1837). *Hymenophyllum acanthoides* = *Meringium*.
- Bursia* Morton (1932). *Hymenophyllum mirificum*.
- Myriodon* Copeland (1936). *Hymenophyllum odontophyllum*.
- Apteropteris* Copeland (1936). *Hymenophyllum mattingii*.

*Artificial key to the genera of the Hymenophyllaceae.*

Real lamina wanting, and replaced.

By filaments cells ..... 5. *Apteropteris*.

By veinless teeth ..... 10. *Myriodon*.

Typical lamina present.

Involucre valvate.

Margin entire and naked.

Frond large, simple ..... 14. *Hymenoglossum*.

Frond minute, simple ..... 2. *Craspedophyllum*.

Frond pinnately divided.

Accessory wings present ..... 9. *Amphipterum*.

Accessory wings absent.

Walls thick, coarsely pitted ..... 8. *Meringium* app.

Walls not coarsely pitted.

Fronds pinnate, axes red-pilose ..... 13. *Scorpiopsis*.

Fronds more compound or without red hairs.

Base of involucre cyathiform, receptacle ex-

serted ..... 3. *Hemicyathea* (*Baileyannum*).

Base of involucre not cyathiform or receptacle

included ..... 1. *Mecodium*.

Margin hairy.

Receptacle included ..... 4. *Sphaerocionium*.

Receptacle long-extruded ..... 12. *Leptocionium*.

Margin toothed.

Receptacle long-exserted.

Accessory wings present..... 9. *Amphipterum*.

Accessory wings wanting.

Base of involucre obconic..... 8. *Meringium*.

Base of involucre cyathiform.

3. *Hemicyathea* (*Dephnechei*).

Receptacle not long-exserted.

Receptacle cylindric or clavate. (Cf. also *Meconium*  
*Reinhardtii* and others.)..... 7. *Hymenophyllum*.

Receptacle subglobose ..... 11. *Bucsa*.

Involucre tubular or obconic, not valvate.

Rhizome filiform, fronds remote.

False veinlets present.

Fronds pinnately divided or compound.

False veinlets in the position of veins.

28. *Dalymnoglomum*.

False veinlets unrelated to veins.... 21. *Crepidomanes*.

Fronds simple or lobed.

With marginal vein ..... 22. *Microgonium*.

Without marginal vein.

Without marginal scales..... 23. *Dalymnoglomum*.

With marginal scales ..... 29. *Lecanidium*.

False veinlets absent.

Fronds marginate.

With hairy axial pads..... 18. *Pleuromanes*.

Naked, without axial pads ... 20. *Crepidopteris*.

Fronds not marginate.

Axes of fronds proliferous..... 19. *Gonocormus*.

Axes not proliferous.

Veins branched within segments.

17. *Polyphlebium*.

Segments one-nerved.

Fronds dichotomous or simple.

6. *Microtrichomanes*.

Fronds pinnate in plan.

Axes coarsely red-pilose.

13. *Serpyllopsis*.

Axes not red-pilose.

16. *Vandenboschia*.

Rhizome stout or fronds clustered.

Cells transversely elongate ..... 33. *Abrodictyum*.

Cells not transversely elongate.

Fronds simple ..... 15. *Cardiomanes*.

Fronds once pinnate.

Oriental ..... 25. *Cephalomanes*.

American.

Fronds not dimorphous .. 26. *Trichomanes*.

Fronds dimorphous.

Sterile fronds pinnate..... 26. *Trichomanes*.

Sterile fronds pinnatifid..... 27. *Foca*.

Fronds more divided.

Segments stiff and very narrow..... 32. *Macroglena*.

Segments broader or soft.

Rhizome creeping, fronds remote.

Fronds soft in texture. (Cf. also *Trichomanes rupestre* and others.)

16. *Vandenboschia*.

Fronds harsh ..... 30. *Selcnodasium*.

Fronds clustered.

Fronds 1 cell thick.

Walls thick, coarsely pitted.

30. *Selcnodasium*.

Walls not coarsely pitted.

American ..... 28. *Trichomanes*.

Palaetropic.

Stipes bristly.

23. *Callistopteris*.

Stipes not bristly.

24. *Nesopteris*.

Fronds thicker ..... 31. *Davalliopsis*.

#### 1. Genus MECODIUM Presl

*Mecodium* PRESL, Epim. Bot. (1852 ?) 258, Nomen.

*Diptlophyllum* VAN DEN BOSCH, Eerste Bijdrage (1861) 322, non *Diptlophyllum* Lehm. (1814).

*Hymenophyllum*, § *Euhymenophyllum* auct. plur., nec rite.

*Hymenophyllum*, § *Sphaerocionium* part. C. Chr., Suppl. Text. (1934).

Analoga *Pleuromanis* in *Hymenophyllaceis* existunt plura, nempe . . . inter *Hymenophylloides* *Mecodium sanguinolentum* (*Hymenophyllum sanguinolentum* Swartz).—PRESL, loc. cit.

Epiphyticae, rhizomate gracile, frondibus remotis, mediocribus vel majoribus, pinnatim decompositis, marginibus integris nudis, parietibus cellularum typice tenuibus, soris pantotactis, involucris aut ad basim aut usque ad laminam frondis bivalvibus, receptaculo incluso.

Type, *M. sanguinolentum* Presl (*Trichomanes sanguinolentum* Forster).

A pantropic and austral genus of about 100 recognized species, the largest genus of the family.

This genus as a whole has remained without a name, first because both Presl and van den Bosch failed to grasp it, leaving it partly or largely in *Hymenophyllum*, and later (beginning with van den Bosch) because it was wrongly construed as *Hymenophyllum* by those who recognized *H. tumbridgense* as foreign to it, and assigned that species to *Leptocionium*.

Presl certainly did not adequately describe his genus *Mecodium*. His description would be inaccurate, even if what he wrote were correct, which it is not. He misconstrued the axial pads of *Pleuromanes*; and there is nothing to justify the statement as to *M. sanguinolentum*, more than as to most species of the family, that it is "analogous" to *Pleuromanes*, as the latter is, still less as he thought it to be. I adopt his generic name because it exists, and its use is preferable to the invention of a new name. The only other generic name proposed for any of these ferns is *Diploophyllum*, invalidated under present rules by *Diploophyllum* Lehm. (1814).

Like *Meringium* and *Vandenboschia*, *Mecodium* includes aberrant species in the far South, vestiges, as I picture the case, of a flora antedating the present evolution of the family, with these genera satisfactorily uniform in the Tropics of both hemispheres. In the Tropics and in the Southern Temperate Zone, with the exceptions just noted, *Mecodium* is one of the most uniform and easily recognized of large genera. Within it are groups common to the two hemispheres—whether because of transoceanic migration or because of separate descent from common Antarctic ancestors, I do not guess. Certainly, however, *M. badii* and *M.<sup>12</sup> cardiculatum* are more nearly related to one another than either is to *M. polyanthos*. In both hemispheres, receptacles, elongate or globose or otherwise dilated, with or without sporangiophores, characterize groups of species; but these differences are so gradual, from species to species, that it would be impracticable (as well as, I believe, unnatural) to use them, as Presl attempted, as generic criteria. This seems to me true also of the branching of the bundle at the base of the sorus, to which van den Bosch attached supergeneric significance; it is conspicuous in *M. rufum* and some relatives, and in occasional other plants, including forms of *M. polyanthos* which I do not distinguish specifically.

Laminæ more than one cell in thickness are a far more remarkable peculiarity. I use them to characterize *Davalliopsis* and *Cardiomanes*, but do not recognize a genus *Diploophyllum*, partly for the reason advanced by Mettenius, that besides fronds wholly thick (when mature and on adult plants) there are

<sup>12</sup> These combinations are made in the list of species, immediately following; their use here in anticipation does not constitute publication, and is less awkward than citation under older names.

others in *Mecodium* which are partially so (*M. demissum*, *M. australe*), so that the distinction is not a sharp one; but more than this, it is because the several species with thick leaves seem independently related to species of the typical family structure, which makes it impossible to combine as a genus the two known species with fronds usually thick throughout.

Included in *Mecodium* are three species, *M. Reinwardtii*, *M. thuidium*, and *M. samoense*, with toothed margin. This margin is denticulate rather than serrulate, and the teeth do not appeal to the eye as the same as those of *Meringium*. *M. thuidium* has little fronds crisped in a degree reminiscent of *Meringium acanthoides*. I have invoked intergeneric hybridization to explain some such resemblances, but in this case do not believe that any affinity exists. It may be recalled that a series of *Meringium* species has entire margins.

#### SPECIES OF MECODIUM

##### *MECODIUM POLYANTHOS* (Swartz) Copeland comb. nov.

*Trichomanes polyanthos* SWARTZ, Prodr. Fl. Ind. Occ. (1788) 127.

*Hymenophyllum polyanthos* SWARTZ, COPELAND, Hymen. (1937) 97, pls. 46, 47.

Pantropic, with very many synonyms.

##### *MECODIUM KUHNII* (C. Christensen) Copeland comb. nov.

*Hymenophyllum Kuhnii* C. CHRISTENSEN, Index (1905) 363; COPELAND, Hymen. (1937) 106, pl. 48.

*Hymenophyllum Meyeri* KUHN, non Presl.

Tropical Africa.

##### *MECODIUM PANICULIFLORUM* (Presl) Copeland comb. nov.

*Hymenophyllum paniculiflorum* PRESL, Hymen. (1842) 147; COPELAND, Hymen. (1937) 110, pl. 51.

PHILIPPINES; BORNEO; JAVA.

##### *MECODIUM NITIDULOIDES* Copeland.

*Hymenophyllum nitiduloides* COPELAND, Hymen. (1937) 112, pl. 52.

LUZON.

##### *MECODIUM OVIDES* (F. v. M. and Baker) Copeland comb. nov.

*Hymenophyllum ovides* F. v. M. and BAKER, Journ. Bot. 28 (1890) 105; COPELAND, Hymen. (1937) 107.

PAPUA.

##### *MECODIUM SANGUINOLENTUM* (Forster) Presl.

NEW ZEALAND.

*MECODIUM RECURVUM* (Gaud.) Copeland comb. nov.

*Hymenophyllum recurvum* GAUMCHAUD, Freyc. Voy. Bot. (1827) 376;  
COPELAND, Hymen. (1937) 108, pl. 49.

#### HAWAII.

*MECODIUM PRODUCTUM* (Kunze) Copeland comb. nov.

*Hymenophyllum productum* KUNZE, Bot. Zeit. 6 (1848) 305; COPELAND,  
Hymen. (1937) 113, pl. 54.

#### JAVA; SUMATRA; BORNEO; PHILIPPINES.

*MECODIUM TOBIAMBUENSE* Kjellberg.

CELEBES. Differs from *M. productum* in having a wingless  
stipe.

*MECODIUM ANGULOSUM* (Christ) Copeland comb. nov.

*Hymenophyllum angulosum* CHRIST, Philip. Journ. Sci. § C 5 (1908)  
269; COPELAND, Hymen. (1937) 109, pl. 50.

#### PHILIPPINES.

*MECODIUM REINWARDTII* (van den Bosch) Copeland comb. nov.

*Hymenophyllum Reinwardtii* VAN DEN BOSCH, Pl. Jungh. I (1856)  
567; Hymen. Javan. 52, pl. 42; COPELAND, Hymen. (1937) 115, pl.  
55.

#### MALAY ISLANDS.

*MECODIUM THUIDIUM* (Harr.) Copeland comb. nov.

*Hymenophyllum thuidium* HARRINGTON, Journ. Linn. Soc. Bot. 16  
(1877) 25; COPELAND, Hymen. (1937) 116, pl. 56.

#### PHILIPPINES; NEW GUINEA.

*MECODIUM SAMOENSE* (Baker) Copeland comb. nov.

*Hymenophyllum samoense* BAKER, Journ. Bot. 1876) 10; COPELAND,  
Hymen. (1937) 117, pl. 57.

#### SAMOA; FIJI; QUEENSLAND.

*MECODIUM EMARGINATUM* (Swartz) Copeland comb. nov.

*Hymenophyllum emarginatum* SWARTZ, Schrad. Journ. (1801) 101;  
Synopsis 148, 377; COPELAND, Hymen. (1937) 118, pl. 58.

#### MALAY ISLANDS; NEW CALEDONIA.

*MECODIUM JAVANICUM* (Spr.) Copeland comb. nov.

*Hymenophyllum javanicum* SPR., Syst. Veg. IV (1827) 132; COPELAND,  
Hymen. (1937) 120, pl. 59.

#### Ceylon to New Caledonia and Eastern Australia.

*MECODIUM PRODUCTOIDES* (J. W. Moore) Copeland comb. nov.

*Hymenophyllum productoides* J. W. MOORE, Bishop Mus. Bull. 102  
(1933) 5.



## SOCIETY ISLANDS.

MECODIUM FIMBRIATUM (J. Sm.) Copeland comb. nov.

*Hymenophyllum fimbriatum* J. SM., Hooker's Journ. Bot. 3 (1841) 418,  
Species Fil. I (1844) 102, pl. 360; COPELAND, Hymen. (1937) 122,  
pl. 60.

## PHILIPPINES.

MECODIUM RIUKIUENSE (Christ) Copeland comb. nov.

*Hymenophyllum riukiense* CHRIST, Ann. Cong. Jard. Bot. Geneva 4  
(1900) 208; COPELAND, Hymen. (1937) 123, pl. 61.

## LOOCHOO ISLANDS.

MECODIUM CORRUGATUM (Christ) Copeland comb. nov.

*Hymenophyllum corrugatum* CHRIST, Bull. Boiss. II 3 (1903) 508;  
COPELAND, Hymen. (1937) 124.

## Western China.

MECODIUM FLABELLATUM (La Bill.) Copeland comb. nov.

*Hymenophyllum flabellatum* LA BILL., Nov. Holl. Pl. 2 (1806) 101,  
pl. 250, fig. 1; COPELAND, Hymen. (1937) 125, pl. 62.

## New Zealand to Queensland and Tahiti.

MECODIUM RUFESCENS (Kirk) Copeland comb. nov.

*Hymenophyllum rufescens* KIRK, Trans. N. Z. Inst. 11 (1879) 457,  
pl. 19A; COPELAND, Hymen. (1937) 126.

## NEW ZEALAND.

MECODIUM LE RATHI (Rea.) Copeland comb. nov.

*Hymenophyllum Le Rathi* ROSENSTOCK, Fedde's Report. 9 (1910) 71;  
COPELAND, Hymen. (1937) 127, pl. 63.

## NEW CALEDONIA.

MECODIUM RARUM (R. Br.) Copeland comb. nov.

*Hymenophyllum rarum* R. BROWN, Fl. N. Holl. (1810) 152; COPELAND,  
Hymen. (1937) 128, pl. 64.

## NEW ZEALAND; AUSTRALIA.

MECODIUM INVOLUCRATUM Copeland.

*Hymenophyllum involucratum* COPELAND, Univ. Calif. Publ. Bot. 12  
(1921) 375; Hymen. (1937) 129, pl. 65.

## RAROTONGA.

MECODIUM WAILERI (M. and B.) Copeland comb. nov.

*Hymenophyllum Waileri* MAIDEN and BRETHER, Proc. Linn. Soc. N. S.  
Wales 35 (1910) 802; COPELAND, Hymen. (1937) 130, pl. 66.

## QUEENSLAND.

*MECODIUM MINIODES* (Baker) Copeland comb. nov.

*Hymenophyllum minioides* BAKER, Syn. Fil. (1873) 57; COPELAND, Hymen. (1937) 131, pl. 67.

#### NEW CALEDONIA.

*MECODIUM MONTANUM* (Kirk) Copeland comb. nov.

*Hymenophyllum montanum* KIRK, Trans. N. Z. Inst. 10 (1877) 394, pl. 24B; COPELAND, Hymen. (1937) 121, pl. 68.

#### NEW ZEALAND.

*MECODIUM INTRICATUM* (van den Bosch) Copeland comb. nov.

*Hymenophyllum intricatum* VAN DEN BOSCH, Ned. Kr. Arch. 53 (1863) 169; COPELAND, Hymen. (1937) 132.

#### TASMANIA.

*MECODIUM FUMARIOIDES* (Willdenow) Copeland comb. nov.

*Hymenophyllum fumarioides* WILLDENOW, Sp. Plant. 5 (1810) 526; COPELAND, Hymen. (1937) 132.

#### South Africa and East African Islands.

*MECODIUM HUMBERTII* (C. Christ) Copeland comb. nov.

*Hymenophyllum Humbertii* C. CHRIST, Arch. Bot. 2 (1928) 209; Dansk Bot. Arkiv. 7 (1932) 10, pl. 2, figs. 6-8; COPELAND, Hymen. (1937) 136.

#### MADAGASCAR.

*MECODIUM VERONICOIDES* (C. Chr.) Copeland comb. nov.

*Hymenophyllum veronicoides* C. CHR., in Bonaparte, Notes Pterid. 12 (1920) 20; Pterid. Madag. 9, pl. 2, figs. 9-12; COPELAND, Hymen. (1937) 135.

#### MADAGASCAR.

The preceding nine species constitute a well-defined group.

*MECODIUM IMBRICATUM* (Blume) Copeland comb. nov.

*Hymenophyllum imbricatum* BLUME, Enum. (1828) 220; COPELAND, Hymen. (1937) 137, pls. 70, 71.

#### MALAYA; POLYNESIA.

*MECODIUM TREUBII* (Raciborski) Copeland comb. nov.

*Hymenophyllum Treubii* RACIBORSKI, Pterid. Buft. (1898) 15; COPELAND, Hymen. (1937) 140, pl. 72.

#### JAVA; NEW GUINEA; PERAK?

*MECODIUM JUNGHUNII* (van den Bosch) Copeland comb. nov.

*Hymenophyllum Jungkunii* VAN DEN BOSCH, Pl. Jungh. I (1856) 570, Hymen. Javan. 50, pl. 49; COPELAND, Hymen. (1937) 143, pl. 73.

#### JAVA; SUMATRA; BORNEO.

**MECODIUM LONGIFOLIUM** (v. A. v. Rosenburgh) Copeland comb. nov.

*Hymenophyllum longifolium* VAN A. v. ROSENBURGH, Bull. Jard. Bot. Buit. (16) II (1914) 17; COPELAND, Hymen. (1937) 142, pl. 74.

CELEBES; PAPUA; JAVA?

**MECODIUM SALAKENSE** (Rachborski) Copeland comb. nov.

*Hymenophyllum salakense* RACHBORSKI, Pterid. Buit. (1893) 13; COPELAND, Hymen. (1937) 143, pl. 75.

JAVA; SUMATRA; BORNEO?

**MECODIUM BADIUM** (H. and G.) Copeland comb. nov.

*Hymenophyllum badium* HOOKER and GREVILLE, Icones Fil. (1828) pl. 76; COPELAND, Hymen. (1937) 144, pl. 76.

India to Formosa and Celebes.

**MECODIUM CRISPATUM** (Wall.) Copeland comb. nov.

*Hymenophyllum crispatum* WALLICH in HOOKER and GREVILLE, Icones Fil. (1823) pl. 77; COPELAND, Hymen. (1937) 148, pl. 77.

India to the Philippines.

**MECODIUM CRISPATO-ALATUM** (Hayata) Copeland comb. nov.

*Hymenophyllum crispato-alatum* HAYATA, Icones pl. Formosa 5 (1915) 256; COPELAND, Hymen. (1937) 149, pl. 79.

FORMOSA.

**MECODIUM FLEXILE** (Makino) Copeland comb. nov.

*Hymenophyllum flexile* MAKINO, Bot. Mag. Tokyo 13 (1899) 46; COPELAND, Hymen. (1937) 150, pl. 80.

JAPAN.

**MECODIUM OPACUM** Copeland.

*Hymenophyllum opacum* COPELAND, Hymen. (1937) 151, pl. 81.

NEW GUINEA.

The preceding ten species are a natural group, with American relatives.

**MECODIUM WRIGHTII** (van den Bosch) Copeland comb. nov.

*Hymenophyllum Wrightii* VAN DEN BOSCH, Synopsis (1859) 51\*; COPELAND, Hymen. (1937) 152, pl. 82.

JAPAN.

**MECODIUM EXSERTUM** (Wall.) Copeland comb. nov.

*Hymenophyllum exsertum* WALLICH in Hooker, Spec. Fil. I (1844) 109, pl. 38A; COPELAND, Hymen. (1937) 153, pl. 83.

INDIA; CHINA; SIAM.

\* The page citation is that of the reprint; to get the pagination in Ned. Kr. Arch. 4, add 840.

**MECODIUM FLEXUOSUM** (A. Cunn.) Copeland comb. nov.

*Hymenophyllum flexuosum* A. Cunningham, HORTICULT. COMP. BOT. MAG. 2 (1836) 367; COPELAND, Hymen. (1937) 154, pl. 84.

NEW ZEALAND.

**MECODIUM PULCHERRIMUM** (Colenso) Copeland comb. nov.

*Hymenophyllum pulcherrimum* COLENSO, Tasm. Journ. Nat. Sci. 2 (1844) 185; COPELAND, Hymen. (1937) 156.

NEW ZEALAND.

**MECODIUM VILLOSUM** (Colenso) Copeland comb. nov.

*Hymenophyllum villosum* COLENSO, Tasm. Journ. Nat. Sci. 2 (1844) 185; COPELAND, Hymen. (1937) 157.

NEW ZEALAND.

**MECODIUM AUSTRALE** (Willdenow) Copeland comb. nov.

*Hymenophyllum australe* WILDENOW, Spec. Pl. 5 (1810) 627; COPELAND, Hymen. (1937) 158, pl. 85.

TASMANIA; NEW ZEALAND; VICTORIA?

**MECODIUM DEMISSUM** (Forster) Copeland comb. nov.

*Trichomanes demissum* FORSTER, Prod. (1786) 85.

*Hymenophyllum demissum* Swartz, COPELAND, Hymen. (1937) 159, pl. 86.

NEW ZEALAND.

**MECODIUM DILATATUM** (Forster) Copeland comb. nov.

*Trichomanes dilatatum* FORSTER, Prod. (1786) 85.

*Hymenophyllum dilatatum* Swartz, COPELAND, Hymen. (1937) 160, pl. 87.

NEW ZEALAND.

**MECODIUM SCABRUM** (A. Rich.) Copeland comb. nov.

*Hymenophyllum scabrum* A. RICHARD, Fl. Nouv. Zel. (1832) 90; COPELAND, Hymen. (1937) 161, pl. 87.

NEW ZEALAND.

**MECODIUM CUNEATUM** (Kunze) Copeland comb. nov.

*Hymenophyllum cuneatum* KUNZE, Annl. (1837) 50.

CHILE; JUAN FERNANDEZ. *H. Darwini* (Hooker) v. d. Bosch must belong here.

**MECODIUM TRIANAE** (Hieron.) Copeland comb. nov.

*Hymenophyllum Trianae* Hieron., Bot. Jahrb. 34 (1904) 429.

From Bolivia to Colombia.

**MECODIUM MULTIFLORUM** (Bos.) Copeland comb. nov.

*Hymenophyllum multiflorum* ROSENSTOCK, Meded. Rijks Herb. Leyden  
No. 19 (1913) 3.

BOLIVIA.

**MECODIUM PERAX** (van den Bosch) Copeland comb. nov.

*Hymenophyllum perax* VAN DEN BOSCH, Synopsis (1859) 52.

ECUADOR; VENEZUELA.

**MECODIUM MICROCARPUM** (Desv.) Copeland comb. nov.

*Hymenophyllum microcarpum* DESVAUX, Prod. (1827) 333.

Tropical America.

**MECODIUM MACROTHECUM** (Fée) Copeland comb. nov.

*Hymenophyllum macrotheicum* FÉE, 11 Mém. (1866) 115, pl. 31, fig. 2.

WEST INDIES.

**MECODIUM MYRIOCARPUM** (Hooker) Copeland comb. nov.

*Hymenophyllum myriocarpum* HOOKER, Sp. Fil. I (1844) 106, pl. 37D.

From Bolivia to Mexico.

**MECODIUM ANDINUM** (van den Bosch) Copeland comb. nov.

*Hymenophyllum andinum* VAN DEN BOSCH, Synopsis (1859) 57.

ECUADOR.

**MECODIUM NIGRICANS** (Presl) Copeland comb. nov.

*Sphacrocinnhon nigricans* PRESL, Linnaea 18 (1844) 536.

Tropical America.

**MECODIUM CONTEXTUM** (Ros.) Copeland comb. nov.

*Hymenophyllum contextum* ROSENSTOCK, Fedde's Repert. 22 (1926)  
3.

COSTA RICA.

**MECODIUM CONSTRICTUM** (Christ) Copeland comb. nov.

*Hymenophyllum constrictum* CHRIST, Bull. Boiss. II 4 (1904) 939.

COSTA RICA.

**MECODIUM PROTRUSUM** (Hooker) Copeland comb. nov.

*Hymenophyllum protrusum* HOOKER, Sp. Fil. I (1844) 104, pl. 37B.

CENTRAL AMERICA; BOLIVIA.

**MECODIUM COSTARRICANUM** (van den Bosch) Copeland comb. nov.

*Hymenophyllum costarricanum* VAN DEN BOSCH, Ned. Kr. Arch. 53  
(1866) 161.

From Costa Rica to Bolivia.

*MECODIUM SILIQUOSUM* (Christ) Copeland comb. nov.

*Hymenophyllum siliquosum* CHRIST, Bull. Boiss. II 4 (1904) 239.

COSTA RICA.

*MECODIUM CONTORTUM* (van den Bosch) Copeland comb. nov.

*Hymenophyllum contortum* VAN DEN BOSCH, Ned. Kr. Arch. 53 (1863) 170.

From Costa Rica to Bolivia.

*MECODIUM RENIFORME* (Hooker) Copeland comb. nov.

*Hymenophyllum reniforme* HOOKER, Sp. Fil. I (1844) 110, pl. 38C.

PERU; ECUADOR.

*MECODIUM DENDRITIS* (Rea) Copeland comb. nov.

*Hymenophyllum Dendritis* ROSENSTOCK, Fedde's Reper. 6 (1909) 308.

BOLIVIA.

*MECODIUM TABLAZIENSE* (Christ) Copeland comb. nov.

*Hymenophyllum tablaizense* CHRIST, Bull. Soc. Bot. Geneve II 1 (1909) 210.

COSTA RICA.

*MECODIUM ALFREDII* (Rea) Copeland comb. nov.

*Hymenophyllum Alfredii* ROSENSTOCK, Fedde's Reper. 22 (1925) 4.

COSTA RICA.

*MECODIUM ABRUPTUM* (Hooker) Copeland comb. nov.

*Hymenophyllum abruptum* HOOKER, Sp. Fil. I (1844) 88, pl. 31B.

Tropical America.

*MECODIUM UNDULATUM* (Swartz) Copeland comb. nov.

*Trichomanes undulatum* SWARTZ, Prod. Fl. Ind. Occ. (1788) 137.

Tropical America.

*MECODIUM FENDLERIANUM* (Sturm) Copeland comb. nov.

*Hymenophyllum fendlerianum* STURM, Fl. Bras. I<sup>2</sup> (1859) 291.

Tropical America.

*MECODIUM AXILLARE* (Swartz) Copeland comb. nov.

*Hymenophyllum axillare* SWARTZ, Schrad. Journ. (1801) 101.

WEST INDIES; VENEZUELA.

*MECODIUM ASPLENIODES* (Swartz) Copeland comb. nov.

*Trichomanes asplenoides* SWARTZ, Prod. Fl. Ind. Occ. (1788) 138.

Tropical America.

*MECODIUM CAUDICULATUM* (Mart.) Copeland comb. nov.

*Hymenophyllum caudiculatum* MARTIUS, Ic. Cr. Brés. (1824) 162, pl. 67.

Patagonia to Brazil and Peru.

2. Genus *CRASPEDOPHYLLUM* (Presl) Copeland gen. nov.

*Hymenophyllum*, § *Craspedophyllum* PRESL, Hymen. (1843) 125.<sup>21</sup>

*Pachytoma* VAN DEN BOSCH, Eerste Bijdrage (1861) 318, non De Candolle.

Frons simplex bilobaque, glabra indusioque marginata. Laciniae integrae. Sorus terminalis sessilis. Indusium bipartitum, integrum. Species novohollandica, mihi solummodo ex icona nota, verosimiliter genus proprium efficiens.—PRESL, loc. cit.

Type, *C. marginatum* (Hooker & Greville) Copeland comb. nov.

*CRASPEDOPHYLLUM MARGINATUM* (Hooker & Greville) Copeland comb. nov.

*Hymenophyllum marginatum* HOOKER and GREVILLE, Ic. Fil. (1828) pl. 84; COPELAND, Hymen. (1937) 163, pl. 89.

A monotypic genus, probably related to *Mecodium*, known from New South Wales and Tasmania; well characterized by the black contents of the obliquely placed marginal cells; internal walls wavy-thickened; involucre valvate to the base; receptacle cylindric, included.

3. Genus *HEMICYATHEON* (Domin) Copeland gen. nov.

*Hymenophyllum* subgenus *Hemicyatheon* DOMIN, Bibl. Bot. 20 Heft 85 (1913) 20.

Pinnulis (segmentis) ultimis integris vel spinuloso-denticulatis; indusis infundibuliformibus parte inferiore connatis sed supra profundo (usque ad medium vel duas partes tertius bilabiatis et campanulato patentibus; receptaculo longe exserto.—DOMIN, loc. cit.

Genus et *Mecodio* et *Meringio* subsimile, frondibus remotis majusculis tripinnatifidis, parietibus cellularum incrassatis, soris magnis pantotactis, involueris deorsum urceolatis sursum bivalvibus, receptaculo extruso.

Typus, II. Baileyanus Domin, loc. cit., sub *Hymenophyllo*.

A genus that I recognize as such because it consists of two species, certainly nearly related, of which one would be aber-

<sup>21</sup> As to this work, I cite the original pagination in Abh. Böhm. Ges. Wiss. V 3 (1843); to get the page numbers of the reprint, cited in Christensen's Index, subtract 92.

rant in *Mecodium* but wholly out of place in *Meringium*, the other aberrant in *Meringium* and woolly misplaced in *Mecodium*. They are alike in general aspect, which would not bar them from either large genus. The walls are less, and less regularly, thickened than in typical *Meringium*, so that the walls, and thus the texture, are intermediate, and would be unusual in either *Meringium* or *Mecodium*. The involucre is also intermediate, cleft as in *Meringium* but with less cuneate base; while unusual there, it can be matched in *Mecodium*. The receptacle is meringoid, but slender. I do not consider *Mecodium* and *Meringium* nearly related, but, far enough back, they did have a common ancestry. *Hemicyathea* may date back that far; or may share the characteristics of the two because of more recent hybridization; or the combination of apparent affinities may be fortuitous.

Range: New Caledonia and Queensland.

#### SPECIES OF HEMICYATHEON

*HEMICYATHEON DAILEYANUM* (Domin) Copeland comb. nov.

*Hymenophyllum Daileyannum* DOMIN, Bibl. Bot. 20 Hef 85 (1913) 20;  
COPELAND, Hymen. (1937) 75, pl. 36.

#### QUEENSLAND.

*HEMICYATHEON DEPLANCHEI* (Hett.) Copeland comb. nov.

*Hymenophyllum Deplanchei* METTENIUS, Linnaea 35 (1868) 392; CORYLAND, Hymen. (1937) 76, pl. 36.

#### NEW CALEDONIA.

#### 4. Genus SPHAEROCIONIUM Presl

*Sphaerocionium* PRESL, Hymen. (1843) 125.

*Dermatophlebium* PRESL, Epim. Bot. (1849) 258.

Costa teres, prominula. Venae pinnatae, alternae, distantes, simplices ramosaeque, steriles venulisque conformibus apice libero desinentes. Sorus in lacinia frondis terminalis, compresso-planus, sessilis. Indusium bifidum, lacinia ovato-orbiculatis obtusis adpressis, demum patentibus. Receptaculum indusio brevius, inferne cylindricum nudum, apice globoso-incrassatum et capsuliferum. Capsulae lenticulares, oblique stipitatae.—PRESL, loc. cit.

Epiphytica, rhizomate repente, radicibus praedito; frondibus remotis, majusculis, pinnatim dissectis, margine costisque (rarius superficie) setis simplicibus vel saepius stellatis obsitis; chromatophoris minutis multis; soris pantotactis, involucre plurimisque profunde fissis, receptaculo incluso.

Tropical America, Florida to Chile, with a few scattered Old World species.



A large genus, distinguished from *Mecodium* by its pubescence, and from *Leptocionium* by the included receptacle. There is closer apparent affinity to *Microtrichomanes*; if this be real, the latter may be regarded as a daughter genus.

Presl based his genus essentially on a single character, a receptacle with a comparatively slender sterile base, and a globose sporangium-bearing head. On this basis he included naked species immediately related to several minor groups in *Mecodium*. The fact that it was thus evidently unnatural is probably responsible for the failure of his successors to recognize it at all. Characterized with emphasis on the pubescence, it is a natural genus, typified by *S. hirsutum*, which must be regarded as the type of Presl's genus. Correcting the long abuse of the term *Euhymenophyllum* and applying it properly to a group with toothed margin, Christensen, in the Third Supplement to the Index, has taken up *Sphaerocionium* as the subgeneric name for all species of *Hymenophyllum* with entire margin. As I construe it, it is the group segregated by Prantl<sup>22</sup> as "Sect. 4. Pilosa." In the Synopsis of van den Bosch this is the group of *Hymenophyllum* with "Frons vestita," species 97-133.

The hairs in a majority of the species are restricted to the axes and margins. When they have long basal cells at the top of which they branch, they cover the surface with a dense felt, even though none originate there. Marginal hairs are regularly placed, as shown by Prantl. The cell from which one springs may or may not be differentiated evidently. Its differentiation may involve the adjacent cells, the hair then being borne on a projection of the margin, a tooth. In a few cases such teeth have been confused with those of *Meringium*, but they are not homologous. Even when the teeth of *Meringium* are prolonged into short hairs, these are rows of cells, and not bristlelike, as are all the simple hairs of *Sphaerocionium*. Stellate hairs usually branch from the end of a stalk cell, but in a few species the stalk cell is wanting and they branch from the base. Throughout the genus the ultimate branches and the simple setae are alike in being nonseptate (above the base or basal cell), and sharp and stiff. There is no sharp line between branched hairs, hairs stellate from the base, paired setae, and simple, solitary setae. In a few species they are mixed. Sometimes the hairs on the rachis are mostly branched, those on the margin mostly simple.

<sup>22</sup> Hymen. 55.

and on some species (as *S. valvatum*) an occasional hair is forked or branched. A branched hair may have a single branch, having a septum, and usually being bent, at the distal end of the stalk cell.

It should be possible to break so large a genus into natural groups, but I do not know these plants intimately enough to do this with any confidence to the genus as a whole. It is not evident that the character of the receptacle can be used in this way, although I include here species with slender receptacles. The involucre, typically cleft nearly to the base, but sometimes with an evident immersed tube, seems likewise to lack significance. It is only as short lips and an elongate involucre are found together, and branched hairs disappear, in a group of apparently related species, reduced and dichotomous rather than pinnate in architecture, that these characters become evidently diagnostic for a group. And then, because the verbal definition of *Sphaerocionium* (in distinction to hairy plants of *Trichomanes*) would become very different otherwise, I feel constrained to recognize a smaller, related genus, *Microtrichomanes*. Generic status (as *Apteropteris*) is given also to one single species hitherto called *Trichomanes*, and *Hymenophyllum Malingii*, because it is isolated among all ferns by vegetative peculiarity; its hairs are those of *Sphaerocionium*.

#### SPECIES OF SPHAEROCIONIUM

With secondary lamellæ present on the axes (*Dermatophlebium*):

*SPHAEROCIONIUM SERICUM* (Sw.) Presl.

Cuba to Bolivia and Brazil.

*SPHAEROCIONIUM TOMENTOSUM* (Kunze) Presl.

ANDES.

*SPHAEROCIONIUM PLUMOSUM* (Kaulf.) Copeland comb. nov.

*Hymenophyllum plumosum* KAULFUSS, Enum. (1824) 267.

*Sphaerocionium aureum* PRESL.

BRAZIL; COSTA RICA.

*SPHAEROCIONIUM PYRAMIDATUM* (Desv.) Copeland comb. nov.

*Hymenophyllum pyramidatum* DESVAUX, Prod. (1827) 332.

ANDES.

*H. fusugasugense* Karsten, Colombia, belongs here. Without secondary lamellæ.

With branched hairs on axes, margin, and surface:

**SPHAEROCIONIUM HIRSUTUM** (Sw.) Presl.

The type of the genus; Cuba and Mexico to Chile.

**SPHAEROCIONIUM RADDIANUM** (K. Müller) Copeland comb. nov.

*Hymenophyllum raddianum* K. MÜLLER, Bot. Zeit. 12 (1854) 723.

BRAZIL.

**SPHAEROCIONIUM INTERRUPTUM** (Kze.) Presl.

Tropical America.

**SPHAEROCIONIUM LANATUM** (Fée) Copeland comb. nov.

*Hymenophyllum lanatum* FÉE, 11 Mém. (1866) 116, pl. 31, fig. 3.

WEST INDIES.

**SPHAEROCIONIUM RUFIGUM** (Fée) Copeland comb. nov.

*Hymenophyllum rufum* FÉE, Crypt. Vasc. Brazil 1 (1859) 198, pl. 70, fig. 4.

BRAZIL.

**SPHAEROCIONIUM SPECTABILE** (Metz.) Copeland comb. nov.

*Hymenophyllum spectabile* METTENIUS ex KUHN, Linnaea 35 (1868) 392.

BOLIVIA.

**SPHAEROCIONIUM BUCHTIENII** (Ros.) Copeland comb. nov.

*Hymenophyllum Buchtienii* ROSENSTOCK, Fedde's Repert. 5 (1908) 229.

BOLIVIA.

**SPHAEROCIONIUM HEMIPTERON** (Ros.) Copeland comb. nov.

*Hymenophyllum hemipteron* ROSENSTOCK, Fedde's Repert. 22 (1925) 4.

COSTA RICA.

**SPHAEROCIONIUM PALMENSE** (Ros.) Copeland comb. nov.

*Hymenophyllum palmense* ROSENSTOCK, Fedde's Repert. 22 (1925) 5.

COSTA RICA.

**SPHAEROCIONIUM WERCKLEI** (Christ) Copeland comb. nov.

*Hymenophyllum Wercklei* CHRIST, Bull. Boiss. 11 4 (1904) 940.

COSTA RICA.

**SPHAEROCIONIUM HYGROMETRICUM** (Poir.) Copeland comb. nov.

*Trichomanes hygrometricum* POIRET, Enc. 8 (1808) 79.

*Sphaerocionium elasticum* (Bory) Presl.

East African Islands.

**SPHAEROCIONIUM SPLENDIDUM** (v. 4. B.) Copeland comb. nov.

*Hymenophyllum splendidum* VAN DEN BOSCH, Ned. Kr. Arch 5\* (1853) 192; COPELAND, Hymen. (1937) 174.

## WEST AFRICA.

Here seem to belong also:

With branched hairs on axes and margin; surface naked:

*HYMENOPHYLLUM ARRUGINOSUM* (Poir.) Casm.

## TRISTAN D'ACUNHA.

*HYMENOPHYLLUM LINDENI* Hooker.

## VENEZUELA; ECUADOR.

*SPHAEROCIONIDIUM CILIATUM* (Sw.) Presl.

Tropical America to East African Islands.

*SPHAEROCIONIDIUM LINEARE* (Sw.) Presl.

## WEST INDIES.

*SPHAEROCIONIDIUM CRUEGERI* (N. Müller) Copeland comb. nov.

*Hymenophyllum Cruegeri* K. Müller, Bot. Zeit. (1854) 722.

West Indies to Brazil.

*SPHAEROCIONIDIUM ANTILLENSE* (Jenman) Copeland comb. nov.

*Hymenophyllum antillense* JENMAN, Bull. Dept. Jam. No. 18 (1890) 6.

## JAMAICA; HISPANIOLA.

*SPHAEROCIONIDIUM ELEGANS* (Spr.) Copeland comb. nov.

*Hymenophyllum elegans* SPR., Syst. Veg. IV (1827) 133.

## BRAZIL; COSTA RICA.

*SPHAEROCIONIDIUM HORTII* (Sw.) Presl.

## WEST INDIES; MEXICO; CENTRAL AMERICA.

*SPHAEROCIONIDIUM DIVERSILOBUM* Presl.

## HISPANIOLA.

*HYMENOPHYLLUM TRAPEZOIDALE* Liebm.

MEXICO. This and the preceding species may be merely freaks.

*SPHAEROCIONIDIUM ELEGANTULUM* (v. d. B.) Copeland comb. nov.

*Hymenophyllum elegantulum* VAN DEN BOSCH, Synopsis 68.

*Hymenophyllum patchellum* Hooker, Sp. Fil. I, pl. 334.

Colombia to Bolivia.

*SPHAEROCIONIDIUM RUZIANUM* Kl.

## VENEZUELA; PERU.

*SPHAEROCIONIDIUM TRICHOPHYLLUM* (H. B. K.) Copeland comb. nov.

*Hymenophyllum trichophyllum* H. B. K., Nov. Gen. et Sp. I (1815) 97.

## BRAZIL; ANDES.

**SPHAEROCIONIDIUM SAMPAIOANUM** (Brade et Ros.) Copeland comb. nov.

*Hymenophyllum Sampaioanum* BRADE et ROSENSTOCK, Bol. Mus. Rio de Janeiro 1 (1931) 136, pl. 1, fig. 2; pl. 3; *Hymenophyllum Sampaioi* in herb.

BRAZIL.

Here seem to belong:

**HYMENOPHYLLUM ADIANTOIDES** van den Bosch.

PERU.

**HYMENOPHYLLUM CRISPATULUM** van den Bosch.

PERU.

**HYMENOPHYLLUM SPRUCEI** Baker.

PERU.

**SPHAEROCIONIDIUM FERRUGINEUM** (Colla) Copeland comb. nov.

*Hymenophyllum ferrugineum* COLLA, Mem. Ac. Torino 39 (1886) 30.  
*Hymenophyllum subtilissimum* Kze.

Chile to New Zealand.

**SPHAEROCIONIDIUM LANCEOLATUM** (Hooker and Arnott) Copeland comb. nov.

*Hymenophyllum lanceolatum* HOOKER and ARNOTT, Bot. Beechey's Voy. (1832) 109.

HAWAII.

**SPHAEROCIONIDIUM OBTUSUM** (Hooker and Arnott) Copeland comb. nov.

*Hymenophyllum obtusum* HOOKER and ARNOTT, Bot. Beechey's Voy. (1832) 109.

HAWAII.

**SPHAEROCIONIDIUM LYALLII** (Hooker) Copeland comb. nov.

*Hymenophyllum Lyallii* HOOKER f., Fl. N. Zealand II (1854) 16.  
*Trichomanes Lyallii* HOOKER, Syn. Fil. (1867) 77; COPELAND, Trich. (1933) 163, pl. 7, fig. 7; pl. 11, fig. 4.

NEW ZEALAND; NEW SOUTH WALES.

**SPHAEROCIONIDIUM PILOSISSIMUM** (C. Chr.) Copeland comb. nov.

*Hymenophyllum pilosissimum* C. CHR., Gardens' Bull. S. S. 7 (1934) 213.

BORNEO; PHILIPPINES; NEW GUINEA.

**SPHAEROCIONIDIUM MARLOTHII** (Brause) Copeland comb. nov.

*Hymenophyllum Marlothii* BRAUSE, Fedde's Report. 11 (1912) 122.

SOUTH AFRICA.

**SPHAEROCIONIDIUM CAPILLARE** (Desf.) Copeland comb. nov.

*Hymenophyllum capillare* DESVAUX, Prod. (1827) 333.  
*Sphaerocionidium pendulum* (Bory) Presl.

Africa and Islands.

**SPHAEROCIONUM POOLII** (Baker) Copeland comb. nov.

*Hymenophyllum Poolii* BAKER, Journ. Linn. Soc. 15 (1876) 413;  
Icones Pl. 1609.

MADAGASCAR.

With unbranched setae:

**SPHAEROCIONUM VALVATUM** (H. and G.) Copeland comb. nov.

*Hymenophyllum valvatum* HOOKER and GREVILLE, Icones Fil. (1831)  
pl. 219.

West Indies to Bolivia.

**SPHAEROCIONUM ELEGANTISSIMUM** (Fée) Copeland comb. nov.

*Hymenophyllum elegantissimum* FÉE, 11 Mém. (1866) 118, pl. 29,  
fig. 2.

WEST INDIES.

**SPHAEROCIONUM MICROCARPUM** (Desv.) Copeland comb. nov.

*Hymenophyllum microcarpum* DESVAUX, Prod. (1827) 39.

Tropical America.

**SPHAEROCIONUM DURANDII** (Christ) Copeland comb. nov.

*Hymenophyllum Durandii* CHRIST, Bull. Boiss. 4 (1896) 657.

COSTA RICA.

**SPHAEROCIONUM SUBRIGIDUM** (Christ) Copeland comb. nov.

*Hymenophyllum subrigidum* CHRIST, Bull. Boiss. II 5 (1905) 260.

COSTA RICA.

**SPHAEROCIONUM SEMIGLABRUM** (Ros.) Copeland comb. nov.

*Hymenophyllum semiglabrum* ROSENSTOCK, Fedde's Repert. 9 (1910)  
67.

COSTA RICA.

Here seems to belong:

**HYMENOPHYLLUM PRANCVILLEI** van den Bosch.

WEST INDIES.

**SPHAEROCIONUM SUBORTUSUM** (Ros.) Copeland comb. nov.

*Hymenophyllum subortusum* ROSENSTOCK, Fedde's Repert. 9 (1910-  
1911) 71; COPELAND, Hymen. (1937) 173.

NEW CALEDONIA.

5. Genus **APTEROPTERIS** Copeland gen. nov.

*Hymenophyllum* subgen. *Apteropteris* COPELAND, Hymen. (1937) 176.

Lamina vera omnino carente, filamentis brevibus cellularum axibus frondis ubique excurrentibus pilis stellatis dense obtectis substituta, segmentis frondis deinde crasse filiformibus haud applanatis.—*Copeland, loc. cit.*

Species unica: *Apteropteris Malingii* (Hooker) Copeland.

*APTEROPTERIS MALINGII* (Hooker) Copeland comb. nov.

*Trichomanes Malingii* HOOKER, Garden Ferns (1862) pl. 64.

*Hymenophyllum Malingii* MERTENIUS, Hymen. 423, pl. 1, fig. 32;

GIESSENHAGEN, Flora (1890) 442, pl. 4, fig. 25; *Copeland, Hymen.* (1937) 176.

Epiphytic, in New Zealand, usually on *Libocedrus Bidwillii*, in Tasmania on *Athrotaxis selaginoides*. The illustrations of Mettenius and Giesenhagen show the structure perfectly. The best description is by Holloway,<sup>25</sup> who calls it "certainly the most peculiar species of the New Zealand family both in its frond structure and in its distribution."

The stellate hairs are unmistakable evidence of affinity to *Sphaerocionium*.

#### 6. Genus *MICROTRICHOMANES* (Mettenius) Copeland gen. nov.

*Trichomanes*, Gruppe *Micro-trichomanes* MERTENIUS, Hymen. (1864) 413.

*Gonocormus*, § *Microtrichomanes* PRANTL, Hymen. 51.

Folia disticha . . . , dichotome v. subpinnatim partita, . . . striis nullis . . . Folium non proliferum, margine saepe ciliatum; indusii tubus latetudinem limbi vix superans; pulvae rectae.—*PRANTL, loc. cit.*

Typice epiphytica, rhizomate filiforme late repente et intricato, radicibus praedito; frondibus parvis, repetiter dichotomis rarissime simplicibus, rhache vera ita carente, costis ubique alatis, margine aut minute setiferis aut nudis; parietibus cellularum tenuibus; soris in apices segmentorum immersis, involucri obconico vel campanulato, non bilabiato, receptaculo gracile modo exserto, sporangiis majusculis.

Typus, *M. digitatum* (Swartz sub *Trichomane*).

A small genus of the Old World Tropics, related to *Sphaerocionium* and probably derived from it.

Range: Malaya to Tahiti and Madagascar.

Dealing with a group presumably derived, by reduction, from ferns with more amply developed fronds, it must be observed, as in other such cases, that reduction is likely to result in convergent evolution, whereby species of diverse ancestry have be-

<sup>25</sup> *Trans. N. Z. Inst.* 54 (1923) 696, pls. 66, 76.

come similar. I may be misled in this manner into including in *Microtrichomanes* some species which do not belong here. So far as marginal setae are present, they present sufficient evidence of affinity to *Sphacrocionium*; and the gap between *S. Lyallii* and *M. palmatifidum* is too narrow to leave reasonable doubt on the subject. They would be treated as congeneric, if the considerable number of species to which they are related in opposite directions did not make convenient an intergeneric boundary between them. As to the species without setae, they seem to be related to those which bear setae; but setae are structures not usually lost in the course of reduction of the fronds.

The relation of *Microtrichomanes* and the still more reduced genera, *Didymoglossum* and *Microgonium*, invites study. Between *Microtrichomanes* and *Gonocormus*, which are united by Prantl, there is no near affinity.

#### SPECIES OF MICROTRICHOMANES

**MICROTRICHOMANES PALMATIFIDUM** (K. Mühl.) Copeland comb. nov.

*Trichomanes palmatifidum* K. Mühl., Bot. Zeit. 12 (1854) 732; VAN DEN BOSCH, Hymen. Javan. 20, pl. 14; COPELAND, Trich. (1933) 162, pl. 7, fig. 6; pl. 11, fig. 1.

JAVA; SUMATRA; BORNEO; MALAY PENINSULA.

**MICROTRICHOMANES RIDLEYI** Copeland.

*Trichomanes Ridleyi* COPELAND, Trich. (1933) 162, pl. 11, figs. 2, 3.

PAHANG.

**MICROTRICHOMANES DIGITATUM** (Sw.) Copeland comb. nov.

*Trichomanes digitatum* SWARTZ, Syn. Fil. (1806) 370; COPELAND, Trich. (1933) 159, pl. 7, figs. 3, 4.

East African Islands; Malaya to Samoa? Christensen<sup>24</sup> would restrict this name to the form found in Madagascar and the Seychelles, recognizing *T. flabellatum* v. d. Bosch, described from Java, as distinct. Three Philippine forms might be distinguished, but probably blend. The following two species are still more aberrant.

**MICROTRICHOMANES DICHOTOMUM** (Kze.) Copeland comb. nov.

*Trichomanes dichotomum* KUNZE, Bot. Zeit. 5 (1848) 236; VAN DEN BOSCH, Hymen. Javan. 22, pl. 16; COPELAND, Trich. (1933) 160, pl. 7, fig. 5.

JAVA.

<sup>24</sup> Pterid. Madag., p. 3.



**MICROTRICHOMANES TENIATUM** Copeland.

*Trichomanes tenuatum* COPELAND, Bishop Mus. Bull. 93 (1932) 6, pl. 2; Trich. (1933) 161, pl. 10.

SOCIETY ISLANDS; SOLOMON ISLANDS.

**MICROTRICHOMANES NITIDULUM** (v. d. B.) Copeland comb. nov.

*Trichomanes nitidulum* VAN DEN BOSCH, Pl. Jungh. (1856) 547; Hymen. Javan. 21, pl. 15; COPELAND, Trich. (1933) 155, pl. 7, fig. 1.

JAVA; SUMATRA; CEYLON; TONKIN; NEW SOUTH WALES. This and the species to follow are without setae.

**MICROTRICHOMANES PARVULUM** (Poir.) Copeland comb. nov.

*Trichomanes parvulum* POIRET, Linn., Fuc. 2 (1805) 64, not of most subsequent authors nor Copeland. Trich. (1933) 145.

*Trichomanes sibthorpioides* Bory, COPELAND, Trich. (1933) 154, pl. 8.

*Hymenophyllum sibthorpioides* Mettenius, C. CHRISTENSEN, Pterid. Madag. 11, pl. 2, figs. 15-18.

East African Islands. The evidence suggested several times by Christensen, and summarized in Pterid. Madag., p. 3, seems to leave little doubt that the original *T. parvulum* is the species later described by Bory as *T. sibthorpioides*, removed to *Hymenophyllum* by Mettenius, and equally out of place there.

**MICROTRICHOMANES FRANCHI** (Christ) Copeland comb. nov.

*Trichomanes Franchi* CHRIST, Bull. Boissier 11 7 (1907) 648; COPELAND, Trich. (1933) 156, pl. 7, fig. 2.

NEW CALEDONIA.

**MICROTRICHOMANES VITIENSE** (Baker) Copeland comb. nov.

*Trichomanes vitiense* BAKER, Journ. Linn. Soc. Bot. 9 (1866) 338, pl. 8, fig. 2; DOMIN, Bibl. Bot. 20: 10, pl. 3, fig. 3; COPELAND, Trich. (1933) 157, pl. 9, figs. 1, 2.

FIJI; SAMOA; QUEENSLAND. The fronds are forked, or reduced to simple.

## 7. Genus HYMENOPHYLLUM Smith

*Hymenophyllum* SMITH, Mém. Acad. Turin 5 (1793) 418.

Sorus marginalis receptaculo cylindraceo insertus. Indusium bivalve sorum includens.—SMITH, loc. cit.

Genus cosmopolitanum filicum terrestrium et epiphyticarum, rhizomate repente, frondibus mediocribus vel parvis pinnatifidis dissectis, marginibus serrulatis nudis, involucris profunde bivalvibus, receptaculo cylindrico interdum supra basin leviter incrassato, aut incluso aut involucro tantum longiore, sporangiis magnis sessilibus.

Type, *H. tunbridgense* (L.) Smith.

A genus of perhaps 25 very similar species, notable for their occurrence in temperate lands, though not wanting in the Tropics. Its near affinity is to *Meringium*, from which it is distinguished by the more deeply cleft involucre, the shorter receptacle, the absence of peculiarly (pitted) thickened cell walls, and usually smaller size. There are species in the far South, perhaps primitive, which share the characteristics of the two genera; and there are very reduced species there and elsewhere which, in the course of reduction, have lost their clear generic criteria. However, *Meringium* in its full development is so different that it seems clearly expedient to maintain both genera.

SPECIES OF HYMENOPHYLLUM

HYMENOPHYLLUM TUNBRIDGENSE (L.) Smith.

Scotland to Italy; Atlantic Islands, South Africa; South America.

HYMENOPHYLLUM BARIATUM Baker.

Japan to India.

HYMENOPHYLLUM SIMONSIANUM Recker.

India to Formosa.

HYMENOPHYLLUM CUPRESSIFORME Lab.

AUSTRALIA.

HYMENOPHYLLUM GRACILESCENS Donin.

AUSTRALIA.

HYMENOPHYLLUM REVOLUTUM Colenso.

NEW ZEALAND.

HYMENOPHYLLUM RUGOSUM C. Christ & Skudlarsky.

JUAN FERNANDEZ.

HYMENOPHYLLUM FALKLANDICUM Baker.

ANTARCTIC AMERICA.

HYMENOPHYLLUM PELTATUM Desv.

All southern lands, to Norway.

HYMENOPHYLLUM ANTARCTICUM Presl.

AUSTRALIA.

HYMENOPHYLLUM AFFINE Brack.

FIJI.

HYMENOPHYLLUM PUMILUM Copeland.

BORNEO.

HYMENOPHYLLUM ASPERULUM Kunze.

ANDES.

HYMENOPHYLLUM HERZOGII Ros.

BOLIVIA.

Dwarfs which may be reduced representatives of either *Hymenophyllum* or *Meringium* are *H. pumilum* Moore, *H. Pumilio* Ros., and *H. minimum* Rich.

*H. Livingei* Clarke, of the Himalayas, described as bearing both hairs and palcae, is otherwise in this genus, but is not to be placed with confidence until so remarkable a peculiarity is verified.

*H. pectinatum* Cav., Antarctic America, belongs in this rather than in any other genus, but is an isolated species, like so many others of the far South.

### 8. Genus MERINGIUM Presl

*Meringium* Presl, *Hymen.* (1843) 116, pl. 8B.

Type epiphyticae, frondibus remotis medioeribus pinnatim decompositis, marginibus serrulatis vel rarius integris, parietibus cellularum saepe valde incrassatis et grosse villatis, soris paratactis, involucris deorsum obconicis sursum bivalvibus, receptaculo praelongo gracile, sporangii sessilibus magnis.

Type, *Meringium mayenianum* Presl.

A genus of 60 or more recognized species, of the Tropics and South Temperate Zone, best developed in the Malay region, with several American species, and but one known in Africa; distinguished from *Hymenophyllum* by the closed lower part of the involucre and the long-exserted receptacle; also, in general, by larger and coarser fronds, with thick and coarsely pitted walls—like those of *Selenodesmium*. From India to Polynesia it is a common and homogeneous group. The New Zealand species are less distinct from *Hymenophyllum* in the development of the walls.

Presl overlooked the affinity to *Hymenophyllum*, compared his type with *Didymoglossum*, and with the group of *Trichomanes rigidum*, and described and pictured the sorus as "basi bibracteatus." As nobody has since seen the bracts, his plant was long unrecognized and supposed to be some *Trichomanes*; while the group it typifies came to be known by the name of another of his genera, really distinct, *Leptocionium*. He also gave generic

names, *Myrmecostylum* and *Ptychophyllum*, to two other South Chilean plants, certainly related to *Meringium*, which I include in the latter. I believe, though, that since migration from a common home farther south the evolution of the American and Oriental groups has been independent.

There is a group of ill-defined species, ranging from Madagascar to the Philippines, which, with some loss of stature, have more or less completely lost the marginal teeth. *M. macroglossum* and *M. pachydermichum* seem always to be entire. *M. ciliatum* is almost so. *M. holochilum* is serrulate, with sparse teeth. Although these entire species have been assigned to most diverse groups—several of them even to *Trichomanes*—there is no question whatever as to their affinity. They complicate a complete diagnosis of *Meringium*, but it is impracticable to separate them from it.

#### SPECIES OF MERINGIUM

##### *MERINGIUM MEYENIANUM* Presl.

*Hymenophyllum meyenianum* COPELAND, Hymen. (1937) 25, pl. 8.

PHILIPPINES; NEW GUINEA.

##### *MERINGIUM BAKERI* Copeland.

*Hymenophyllum Bakeri* COPELAND, Sarawak Mus. Journ. 2 (1917) 269; Hymen. (1937) 29.

Southern Philippines to Sumatra.

##### *MERINGIUM KLATATENSE* (Christ) Copeland comb. nov.

*Hymenophyllum klatatense* CHRIST, Verh. Nat. Ges. Basel 11 (1894) 4; COPELAND, Hymen. (1937) 30.

CELEBES; MINDANAO.

##### *MERINGIUM VITTATUM* Copeland.

*Hymenophyllum vittatum* COPELAND, Hymen. (1937) 31, pl. 9, figs. 1-3.

LUZON.

##### *MERINGIUM BICOLORIUM* Copeland.

*Hymenophyllum bicolorium* COPELAND, Hymen. (1937) 31, pl. 10.

LUZON.

##### *MERINGIUM CAMPANULATUM* (Christ) Copeland comb. nov.

*Hymenophyllum campanulatum* CHRIST, Philip. Journ. Sci. § C 2 (1907) 155; COPELAND, Hymen. (1937) 32, pl. 11.

NEGROS (Philippines).

**MERINGIUM BONTOCENSE** Copeland.*Hymenophyllum bontocense* COPELAND, Hymen. (1937) 33, pl. 12.

LUZON.

**MERINGIUM MERRILLI** (Christ) Copeland comb. nov.*Hymenophyllum Merrilli* CHRIST, Philip. Journ. Sci. § C 2 (1907) 154; COPELAND, Hymen. (1937) 33, pl. 13.

LUZON.

**MERINGIUM RAMOSII** Copeland.*Hymenophyllum Ramosii* COPELAND, Hymen. (1937) 34, pl. 9, figs. 4-6.

MINDANAO.

**MERINGIUM HOLOCHILUM** (v. d. B.) Copeland comb. nov.*Didymoglossum holochilum* VAN DEN BOSCH, Pl. Jungh. I (1856) 561.*Hymenophyllum holochilum* C. Chr., COPELAND, Hymen. (1937) 34, pl. 14.

Java to Papua and Malay Peninsula.

Apparent relatives of *M. holochilum* are *Hymenophyllum rufifolium* v. A. v. Rosenburgh, *H. rufifrons* v. A. v. R., *H. Elberti* Rosenstock, *H. brevifrons* v. A. v. R., *H. torricellianum* v. A. v. R., *H. ellipticosorum* v. A. v. R., *H. nutantifolium* v. A. v. R., *H. pedicularifolium* Cesati, and *H. cincinnatum* Gepp.

**MERINGIUM EDENTULUM** (v. d. B.) Copeland comb. nov.*Leptocionium edentatum* VAN DEN BOSCH, Ned. Kr. Arch. 53 (1863) 148.*Hymenophyllum edentatum* C. Christ, COPELAND, Hymen. (1937) 24, pl. 7.

ASSAM; LUZON; BORNEO.

**MERINGIUM PACHYDERMICUM** (Cesati) Copeland comb. nov.*Hymenophyllum pachydermicum* CESATI, Attil. Accad. Napoli 2 (1876) 8; COPELAND, Hymen. (1937) 20, pl. 5.

Philippines to Sumatra.

**MERINGIUM PENANGIANUM** (M. and C.) Copeland comb. nov.*Hymenophyllum penangianum* MATTHEW and CHRIST, Journ. Linn. Soc. Bot. 39 (1909) 214; COPELAND, Hymen. (1937) 19, pl. 4.

BORNEO; MALAY PENINSULA.

**MERINGIUM MACROGLOSSUM** (v. d. B.) Copeland comb. nov.*Hymenophyllum macroglossum* VAN DEN BOSCH, Ned. Kr. Arch. 5 (1863) 156; COPELAND, Hymen. (1937) 19, pl. 3.

CEYLON.

**MERINGIUM TENELLUM** (Jacq.) Copeland comb. nov.*Adiantum tenellum* JACQ., Coll. Bot. III (1789) 257, pl. 21, fig. 3.*Hymenophyllum ricciacifolium* Bory. COPELAND, Hymen. (1937) 17, pl. 1.

## East African Islands.

**MERINGIUM POLLENIANUM** (Ros.) Copeland comb. nov.*Hymenophyllum pollenianum* ROSENSTOCK, Meded. Rijks Herb. Leyden

No. 11 (1912) 1; COPELAND, Hymen. (1937) 18, pl. 2.

## MADAGASCAR.

**MERINGIUM PULCHRUM** Copeland.*Hymenophyllum pulchrum* COPELAND, Hymen. (1937) 22, pl. 6.

## Southern Philippines.

Apparently in the same group as the preceding seven species, with margins entire or nearly so, are *H. batuense* Ros., Batu Island, and *H. Hallieri* Ros., Borneo.

**MERINGIUM BRACHYGLOSSUM** (A. Br.) Copeland comb. nov.*Hymenophyllum brachyglossum* A. BR., Bot. Zeit. 5 (1847) 227;

COPELAND, Hymen. (1937) 40.

## JAVA.

**MERINGIUM DENTICULATUM** (Sw.) Copeland comb. nov.*Hymenophyllum denticulatum* SWARTZ, Schrad. Journ. (1801) 100,

Synopsis (1806) 143, 375; COPELAND, Hymen. (1937) 41, pl. 15.

## Ceylon to Fiji.

**MERINGIUM HOSSEI** Copeland.*Hymenophyllum Hossei* COPELAND, Philip. Journ. Sci. § C 12 (1917)

46; Hymen. (1937) 45, pl. 16.

## BORNEO.

This transfer precludes that of the same specific name for the earlier *Trichomanes Hossei* which is *Meringium penangianum*; the purpose being to avoid a new specific name for *H. Hossei*.

**MERINGIUM ACANTHOIDES** (v. d. B.) Copeland comb. nov.*Didymoglossum acanthoides* VAN DEN BOSCH, Pl. Jungh. I (1853) 16.*Hymenophyllum acanthoides* ROSENSTOCK, COPELAND, Hymen. (1937) 45, pl. 17.

## Java to Luzon; FORMOSA; NEW GUINEA.

**MERINGIUM CARDUNCULUS** (C. Chr.) Copeland comb. nov.

*Hymenophyllum Cardunculus* C. CHRISTENSEN, Mitt. Inst. Bot. Hamburg 7 (1928) 144; COPELAND, Hymen. (1937) 47.

## BORNEO.

**MERINGIUM KERIANUM** (Watts) Copeland comb. nov.

*Hymenophyllum kerianum* WATTS, Proc. Linn. Soc. N. S. Wales 39  
(1915) 767; COPELAND, Hymen. (1937) 48.

**QUEENSLAND.****MERINGIUM MACROSORUM** (v. A. v. R.) Copeland comb. nov.

*Hymenophyllum macrosorum* v. A. v. ROSENBERG, Bull. Jard. Bot.  
Buit. 16 (1914) 18; COPELAND, Hymen. (1937) 48.

**SUMATRA.****MERINGIUM LOBBII** (Moore) Copeland comb. nov.

*Hymenophyllum Lobbi* MOORE in van den Bosch, Ned. Kr. Arch. 5\*  
(1833) 176; COPELAND, Hymen. (1937) 49.

**BORNEO.****MERINGIUM BLANDUM** (Racib.) Copeland comb. nov.

*Hymenophyllum blandum* RACIBURSKI, Pterid. Buit. (1893) 29; COPE-  
LAND, Hymen. (1937) 50, pl. 18.

**Java to Luzon.****MERINGIUM REDUCTUM** Copeland.

*Hymenophyllum reductum* COPELAND, Hymen. (1937) 53, pl. 20.

**PHILIPPINES.****MERINGIUM ROSENSTOCKII** (Brause) Copeland comb. nov.

*Hymenophyllum Rosenstockii* BRAUSE, Bot. Jahrb. 56 (1920) 43; COPE-  
LAND, Hymen. (1937) 53, pl. 21, figs. 1, 2.

**NEW GUINEA.**

*Hymenophyllum Herterianum* Brause may belong here; I have  
not seen the sorus.

**MERINGIUM DIMIDIATUM** (Metz.) Copeland comb. nov.

*Hymenophyllum dimidiatum* METZENIUS, Linnaea 35 (1868) 392; COPE-  
LAND, Hymen. (1937) 54.

**NEW CALEDONIA.****MERINGIUM OVATUM** Copeland.

*Hymenophyllum ovatum* COPELAND, Philip. Journ. Sci. § C 6 (1911)  
70; Hymen. (1937) 56, pl. 22.

**PAPUA.****MERINGIUM RUBELLUM** (Ros.) Copeland comb. nov.

*Hymenophyllum rubellum* ROSENSTOCK, Nova Guinea 2 (1912) 716;  
COPELAND, Hymen. (1937) 56.

**NEW GUINEA.**

**MERINGIUM FIRMUM** (v. A. v. B.) Copeland comb. nov.

*Hymenophyllum firmum* v. A. v. ROSENBERGH, Nova Guinea 14 (1924)  
28; COPELAND, Hymen. (1937) 57.

#### NEW GUINEA.

**MERINGIUM GORGONEUM** Copeland.

*Hymenophyllum gorgoneum* COPELAND, Hymen. (1937) 60, pl. 26.

#### SOLOMON ISLANDS.

**MERINGIUM MACGILLIVRAYI** (Baker) Copeland comb. nov.

*Trichomanes Macgillivrayi* BAKER, Ann. Bot. 5 (1891) 195.  
*Hymenophyllum Macgillivrayi* COPELAND, Hymen. (1937) 60, pl. 25.

#### FIJI.

**MERINGIUM FEEJEENSE** (Brack.) Copeland comb. nov.

*Hymenophyllum feejeense* BRACKENRIDGE, U. S. Expl. Exped. 16  
(1854) 266, pl. 37; COPELAND, Hymen. (1937) 61, pl. 27.

#### FIJI.

**MERINGIUM PRAETERVISUM** (Christ) Copeland comb. nov.

*Hymenophyllum praetervisum* CHRIST, Bot. Jahrb. 23 (1896) 338;  
COPELAND, Hymen. (1937) 62, pl. 28.

#### SAMOA.

*Hymenophyllum minimum* Richard, *H. pumilum* Moore, and  
*H. pumilio* Ros., are exceedingly reduced species, which may be-  
long here.

**MERINGIUM MULTIFIDUM** (Forster) Copeland comb. nov.

*Trichomanes multifidum* FORSTER, Prod. (1786) 85.  
*Hymenophyllum multifidum* Swartz, COPELAND, Hymen. (1937) 65, pl.  
30, figs. 1-3.

#### NEW ZEALAND.

**MERINGIUM BIVALVE** (Forster) Copeland comb. nov.

*Trichomanes bivalve* FORSTER, Prod. (1786) 84.  
*Hymenophyllum bivalve* Swartz, COPELAND, Hymen. (1937) 66, pl. 30,  
figs. 4-6.

New Zealand to Queensland.

The preceding two species have the sori and aspect of *Merin-*  
*gium*, and are therefore included in it; but the structure is  
rather that of *Hymenophyllum*. They may represent an evolu-  
tionary stage prior to the typical differentiation of the two  
genera.

**MERINGIUM TRIANGULARE** (Baker) Copeland comb. nov.

*Hymenophyllum triangulare* BAKER, Syn. Fil. (1873) 69; COPELAND,  
Hymen. (1937) 67.

#### AFRICA.



**MERINGIUM TORTUOSUM** (H. and C.) Copeland comb. nov.

*Hymenophyllum tortuosum* HOOKER and GREVILLE, *Icones Fil.* (1829) pl. 129.

*Myrmecostylus tortuosus* PRESL, *Hymen.* 119, pl. 10A.

**ANTARCTIC AMERICA.**

**MERINGIUM Plicatum** (Kaulf.) Copeland comb. nov.

*Hymenophyllum plicatum* KAULFUSS, *Enum.* (1824) 268.

*Ptychophyllum plicatum* PRESL, *Hymen.* 120, pl. 11E.

**ANTARCTIC AMERICA.**

The two preceding species are the types of Presl's cited genera. To me they seem to be very typical *Meringium*, conforming in wall structure, margin, and involucre, and, so far as my poor fruiting material shows, in receptacle. The more or less overfull and therefore ruffled or crisped lamina of *M. plicatum* is no novelty in the genus. Presl described and figured one valve of the involucre as cleft to the base. I have seen such a monstrosity, very rarely, in Philippine species, and do not find it in the material in hand of *M. plicatum*.

*H. quadrifidum* Philippi is described as having a 4-valved involucre. If this is a fixed character, not a remarkable abnormality, the subject will best be regarded, as he suggested, as constituting a genus *Tetralasma*. I have now (May, 1938), by the kindness of Mr. Gualterio Looser, a photograph of part of the original collection of this plant, and am sure that the quadrifid involucre is not a constant peculiarity. The species appears to be *M. magellanicum*.

**MERINGIUM MAGELLANICUM** (Desv.) Copeland comb. nov.

*Didymoglossum magellanicum* DESVAUX, *Prod.* (1827) 331.

**ANTARCTIC AMERICA**, southern Brazil. Typical *Meringium*, throughout its range.

**MERINGIUM SECUNDUM** (H. and C.) Copeland comb. nov.

*Hymenophyllum secundum* HOOKER and GREVILLE, *Icones Fil.* (1829) Pl. 123.

**ANTARCTIC AMERICA.** The internal walls are somewhat reticulate-thickened.

**MERINGIUM FUCOIDES** (Sw.) Copeland comb. nov.

*Trichomanes fucoides* SWARTZ, *Prod. Fl. Ind. Occ.* (1788) 136.

**Tropical America.** Internal walls feebly reticulate-thickened.

*H. dentatum* Cav., southern Chile, has the margin and involucre of *Meringium*, but is otherwise too distinct for easy inclusion. Neither does it go naturally into any other genus. In

its sharing of the characteristics of the modern genera it impresses me as more generalized than *M. multifidum*, in that it seems related to *Mecodium*, which is not in general by any means as close to *Meringium* as is *Hymenophyllum*.

### 9. Genus AMPHIPTERUM Presl

*Amphipterum* PRESL, Epim. Bot. (1852) 258.

Altior evolutionis gradus est ille, si raches costaque venaeque ala foliacea libera bilateraliter serrata in pagina superiori frondis instructae sunt.—Talem organisationem exhibet inter Trichomanoides *Amphipterum fuscum* (*Trichomanes fuscum* Blume, . . . —PRESL, loc. cit.

Genus *Meringio* derivatum, venis aut inferne aut utraque facie alis vel cristis accessoriis praeditis distinguendum; margine aut serrulato aut integra; soris magnis segmenta axillaria abbreviata tertiaria (vel sursum secundaria) terminantibus, involucri vix ad mediam longitudinem bilabiato, deorsum cristato vel laminato, receptaculo valde extruso.

As in the case of some other genera for which I use Presl's names, he left them really *nomina auda*, except as the citation of a species serves perfectly for their identification. In the case of *Amphipterum*, in contrast to *Mecodium*, what little he wrote to characterize it is approximately correct. The accessory wings are the sole distinction from *Meringium*. There are several species of *Sphaerocionium* with similar structures, and they probably constitute a natural group; I do not set this group up as a genus, because such a genus would shade into *Sphaerocionium*, and its recognition would not facilitate the definition or recognition of the parent genus. *Amphipterum* is clear-cut; that is, there is no known species with incipient or occasional accessory wings. And its recognition facilitates that of *Meringium*, because two of its species have entire margins. It is true that species with entire margin remain in *Meringium*; these are not near relatives of *Amphipterum*, and cannot be set off generically because they intergrade in this respect with the parent.

Four species are known to me, ranging from Sumatra to Papua.

#### SPECIES OF AMPHIPTERUM

AMPHIPTERUM FUSCUM (Blume) Presl.

*Trichomanes fuscum* BLUME.

*Hymenophyllum fuscum* VAN DEN BOSCH, Hymen. Javan. 62 pl. 51, 52B; COPELAND, Hymen. (1937) 69, pl. 31.

JAVA; SUMATRA.

AMPHIPTERUM LEDERMANNI (Brause) Copeland comb. nov.

*Hymenophyllum Ledermanni* BRAUSE, Bot. Jahrb. 50 (1920) 41; COPELAND, Hymen. (1937) 70, pl. 32.

NEW GUINEA. *H. cernuum* Gepp may provide the correct specific name of this species.

AMPHIPTERUM GELUENSE (Rox.) Copeland comb. nov.

*Hymenophyllum geluense* ROSENSTOCK, Fedde's Repert. 5 (1908) 372; COPELAND, Hymen. (1937) 72, pl. 33.

NEW GUINEA.

AMPHIPTERUM LAMINATUM Copeland.

*Hymenophyllum laminatum* COPELAND, Philip. Journ. Sci. § C 6 (1911) 70; Hymen. (1937) 73, pl. 34.

PAPUA.

#### 10. Genus MYRIODON Copeland gen. nov.

*Hymenophyllum* subgenus *Myriodon*, COPELAND, Hymen. (1937) 73.

Lamina normale continua omnino eurenta, dentibus longitudinalibus ad rachin costasque ubique et irregulariter affixis substituta, involucri medio fissi ubique dentifero, receptaculo extruso.—COPELAND, loc. cit.

Type, *M. odontophyllum* Copeland.

A genus of a single known species, derived from *Meringium* and more particularly related to *M. denticulatum*. The frond looks so like the exceedingly crisped one of *M. acanthoides* that Brause described this as a variety of that species. But less superficial examination shows that instead of a crisped lamina it has no continuous lamina whatever, no particle of green tissue containing a vein, being thus almost unique among ferns. Its assimilating tissue consists of aplobiate teeth, as that of *Apteropteris*, consists of filaments.

#### SPECIES OF MYRIODON

MYRIODON ODONTOPHYLLUM Copeland.

*Hymenophyllum odontophyllum* COPELAND, Hymen. (1937) 73, pl. 35.

NEW GUINEA.

#### 11. Genus BUESIA (Morton) Copeland gen. nov.

*Hymenophyllum* subgenus *Buesia* MORTON, Bot. Gaz. 93 (1932) 336.

Filix pendula, rhizomatibus longe repentibus; stipites et rhachis paleis pluri-cellularibus basi cellularis 2- vel 3-seriatis planis instructi; rhachis primariae secundariaeque flexuosissimae; laminac elongatae pinnatae, pinnis tripinnatifidis; segmenta ultima serrata; sori in lobulis intimis contractis abbreviatis dispositi; indusium bifidum margine undulatum; receptaculum subglobosum crassum.

Species typica: *Hymenophyllum mirificum* Morton.—MORTON, loc. cit.

Genus *Meringio* affine, alis axium majorum in paleas dissolutis, margine serrulato, soris paratactis involucris profunde bivalvibus, receptaculo breve crasso.

I follow Morton's suggestion and treat this as a genus, although it is not very distinct from *Meringium* as here, perhaps too broadly, construed. The same palealike structures occur on *Meringium plicatum*, are reported on *Hymenophyllum Leringii*, and completely replace the usual lamina of *Myriodon*.

#### SPECIES OF BUESIA

*BUESIA MIRIFICA* (Morton) Copeland comb. nov.

*Hymenophyllum mirificum* MORTON, Bot. Gaz. 93 (1932) 336, fig. 1.

PERU.

*BUESIA SODIROI* (C. Christ) Copeland comb. nov. Plate 2.

*Hymenophyllum Sodiroi* C. CHRIST, Index (1905) 368; *H. pendulum* (SODIRO non Bory).

ECUADOR.

*Buesia Sodiroi* is a stouter and less finely dissected species with huge sori. I conclude from Morton's description of *H. mirificum* that besides the paleae in the natural position of fragments of the wing, they are found scattered (sparsim), but on the frond given me by the National Herbarium they seem all to originate in the plane of the lamina. This is true of most of them on *B. Sodiroi*, but a few are unmistakably inserted out of this plane; which is less startling because they are inserted in all planes on the axes of *Myriodon*. Having seen these structures on *B. Sodiroi*, I can interpret the description and figure of another species, not seen, and confidently call it:

*BUESIA JAMESONI* (Hooker) Copeland comb. nov.

*Hymenophyllum Jamesoni* HOOKER, Spec. Fil. I (1844) 96, pl. 35A.

ECUADOR. Except that the fertile segments are not constricted below them, the sori are exactly those of *B. Sodiroi*.

#### 12. Genus LEPTOCIONIUM Presl

*Leptocionium* PRESL, Hymen. (1843) 118, 11 D.

Venae pinnatae, simplices, prominulae, libere desinentes. Sorus terminalis, sessilis. Indusium usque fere ad basim bipartitum suborbiculatum, laciniis planis appressis margine aequaliter serrato-ciliatis. Receptaculum cylindricum, obtusum, undique capsuliferum, junius indusio aequitongum, adultum duplo longius nudum cicatriculis oblongis spiralibus notatum. Capsulae lenticulares, sessiles.

Genus inter *Trichomanoides* et *Hymenophylloides* intermedium, priorum receptaculum, posteriorum indusium possidens.—PRESL, loc. cit.

A single species, *L. dicranotrichum* Presl, of southern Chile. (Plate 3.)

Actually, the margin is entire, as Presl drew it. Margin and surface bear many very short setae, which are mostly geminate. *Leptocionium* has the sorus of *Meringium*, and the margin and setae of *Sphaerocionium*, the setae short and simple, commonly pinnate.

Not knowing or appreciating Presl's *Meringium*, which has page priority, van den Bosch adopted Presl's name *Leptocionium* for all Hymenophyllaceae with toothed margins, and the use of the name in this sense, as a subgenus, has been usual since his time, but is corrected in the third Supplement to Christensen's Index.

### 13. Genus SERPYLLOPSIS van den Bosch

*Serpyllopsis* VAN DEN BOSCH (Synopsis p. 37, nomen), Versl. Akad. Wetens. Amsterdam 11 (1861) 318.

Fronds pinnate, pinnae simplices integrae vena simplici percursae, sori laterales, receptaculum incrassatum teres.—VAN DEN BOSCH, loc. cit.

Christensen amplified the generic description, emphasizing: "1) the indefinite growth of the leaves, and 2) the pubescence of thick red hairs along the rachis and midribs of pinnae beneath."<sup>23</sup>

The type species, and the only species named as in the genus, is *S. caespitosa* (Gaud.) C. Chr.<sup>26</sup> (Plate 4), *S. antarctica* v. d. Bosch.

Range: Antarctic America, Falkland Islands, Juan Fernandez. Christensen<sup>27</sup> recognized three varieties, besides the typical form. Of these, two have specific names in *Hymenophyllum*: *H. densifolium* Philippi, with deeply bilabiate involucre with obscurely dentate lips; and *H. Dusenii* Christ, the involucre with entire, truncate mouth, but with few and spatulate pinnae and evident, filiform stipe. The typical form has subsessile fronds and pinnae with broadly rounded bases, and the involucre very shallowly bilabiate with dentate lips. Christensen and Skottsberg<sup>28</sup> described still another variety, *fernandeziana*, with deeply immersed and broadly winged involucres cleft halfway down, and dentate lips crested on the back.

<sup>23</sup> Arkiv. f. Bot. 10<sup>1</sup> (1910) 28.

<sup>26</sup> Archiv f. Bot. 10<sup>2</sup> (1910) 29.

<sup>27</sup> Loc. cit.

<sup>28</sup> Pterid. of Juan Fernandez (1920) 5.

Aside from the fructification, there is a strong but perhaps superficial resemblance to *Hymenophyllum rarum*, and the far southern occurrence of both makes their affinity a reasonable conjecture. Even if this were established, it would remain expedient to maintain *Serpyllopsis* as a genus, whether with one or with three or more known species.

#### 14. Genus HYMENOGLOSSUM Presl

*Hymenoglossum* Presl, *Hymenophyllaceae* (1843) 127.

Costa utrinque teres, prominula flexuosa. Venae oppositae, suboppositae alternaeque, angulo acuto orientes, parallelae, utrinque prominulae, simplicissimae, in directis frondis marginatae excurrentes, ante marginem obtuse desinentes. Sori in dentibus frondis apicales.

Rhizoma repens, filiforme . . . Frondes glaberrimae.

Species. *Hymenoglossum eruentum* (*Hymenophyllum eruentum* Cav.).

—Presl, loc. cit.

Range: Chile, Juan Fernandez.

The genus was retained by van den Bosch<sup>20</sup> and by Christensen and Skottsberg;<sup>21</sup> was unknown to Prantl, and is included in *Hymenophyllum* by other authors, including Christensen. In that genus it is isolated by characters of form and structure. As to form, the fronds are simple and large, about 10 cm long and broadly lanceolate; no other species in the family resembles it. The veins are simple, remote, parallel. The margin varies from subentire (sterile) to obtusely serrate, with a sorus at the end of each tooth, half-immersed and cleft halfway down, the lips entire, receptacle included. Anatomical characters are a broad marginal band two cells thick, and a thickened line around each parenchyma cell next to the outside wall.<sup>21</sup> (Plate 5.)

There is no evident particular affinity to any other species or group.

#### 15. Genus CARDIOMANES Presl

*Cardiomanes* Presl, *Hymen.* (1843) 104.

Costa nulla. Venae pedato-flabellatae, crenatae, foveolatae, steriles ante marginem frondis apice obtuso desinentes. Sorus intramarginalis, immersus. Indusium campanulatum, ore integrum. Capsulae lenticulares, receptaculo clavato obtuso demum exserto undique affixae.—Presl, loc. cit.

Terrestre, rhizomate valido, late repente; stipitibus remotis, erectis; fronde simplice, reniforme, majuscula, coriacea, stratis

<sup>20</sup> Synopsis 45, Bijdragen.

<sup>21</sup> Pteridophyta of Juan Fernandez. Nat. Hist. Juan Fernandez 2 (1920)

<sup>22</sup> Mettenius, *Hymen.* (1864) pl. 2, fig. 33.

ca. IV cellularum composita, venis flabellato-dichotomis; soris marginalibus, involucri cylindricis immersis, receptaculo exserto.

A single species (Plate 6), perhaps the most isolated in the family, endemic in New Zealand.

CARDIOMANES RENIFORME (Poester) Presl.

16. Genus VANDENBOSCHIA Copeland gen. nov.

*Trichomanes auctorum omnium, partim.*

*Trichomanes*, § *Eutrichomanes* PRESL, VAN DEN BOSCH, PRANTL, partim.

Type epiphyticae, rhizomate elongato scandente, frondibus remotis, pinnatim dissectis; parietibus cellularum tenuibus, ubique conformibus; soris pantolactis, involucri infundibuliformibus ore non bilabiatis, receptaculis gracilibus protrusis, sporangiiis parvis. Species typica: *V. radicans* (Swartz sub *Trichomanes*).

Range: That of the family.

This is the most nearly cosmopolitan genus in the family. Among those which have been included in *Trichomanes*, it is the least differentiated; on this ground I regard it as most nearly primitive. A considerable number of the genera of more limited geographic range are evidently derived from it. Thus, *Cephalomanes* in the Orient can be derived approximately from the Oriental *V. auriculata*; while *Trichomanes*, an American genus, is traced back approximately through the American *T. rupestra* to *Vandenboschia*; the two lines of distinct origin being superficially so parallel in evolution that Prantl combined parts of them in one small genus, *Lacostea*. Other probable derivatives of *Vandenboschia* are the pantropic *Selcnodesmium* (prior to dispersal from the Antarctic), the American *Davalliopsis* and *Didymoglossum*, and the Oriental *Crepidopteris*, *Crepidomanes*, *Callistopteris*, *Nesopteris*, and *Pleuromanis*.

The failure of this very well-known group to bear any distinctive and valid name is explained under *Trichomanes*, as due to the misapplication of that name to this group.

SPECIES OF VANDENBOSCHIA

VANDENBOSCHIA PHILIPPINA (Stuebel) Copeland comb. nov.

*Trichomanes Philippinum* STUEBEL, Enum. Pl. r. vase. Chil. (1858)

38; VAN DEN BOSCH, Goddijn, Meded. Rijk's Herb. Leyden No. 17

(1913) 24, fig. 13; CHRISTENSEN and SLOTTESBOE, Pterid. Juan

Fernandez (1920) 2, fig. 1.

JUAN FERNANDEZ.

This is the most generalized species of the old genus *Trichomanes*. The fronds are either remote or clustered, and our limited material indicates the absence of sharp distinction between rhizome and stipe. This strongly suggests *Gonocormus*, to which van den Bosch, as far as I can see, did not refer it. (His number, 8a,<sup>22</sup> places it with *T. dichotomum*, a *Microtrichomanes*.) The involucre is variable in form, but sufficiently like that of *V. pyxidifera*. The very large cells suggest *Macroglena*. The stipellate walls of the marginal cells, and sometimes the submarginal, are altogether peculiar. This species may constitute a genus; but I prefer to let the most generalized number of the group stand at the bottom of the least specialized, and in that sense most primitive, genus.

*VANDENBOSCHIA INGAE* (C. Chr.) Copeland comb. nov.

*Trichomanes Ingae* C. Chr., Christensen and Skottsborg, Pterid. Junn Fernandez (1920) 3, fig. 2.

JUAN FERNANDEZ.

Here probably belongs *T. pyxidiferum* var. *marchionicum* E. Brown.

*VANDENBOSCHIA COLENSOI* (Hooker) Copeland comb. nov.

*Trichomanes Colensoi* HOOKER, f. Icones Pl. 10 (1854) 979; HOLLOWAY, Trans. N. Z. Inst. 54 (1922) pl. 73; COPELAND, Trich. (1933) 137, pl. 3.

NEW ZEALAND.

*VANDENBOSCHIA FALLAX* (Christ) Copeland comb. nov.

*Trichomanes fallax* CHRIST, Ann. Mus. Congo V 3 (1909) 24; CHRISTENSEN, Dansk Bot. Arkiv, 7 (1932) 5, pl. 1, figs. 1, 2.

WEST AFRICA; MADAGASCAR.

*VANDENBOSCHIA DRAYTONIANA* (Brack.) Copeland comb. nov.

*Trichomanes draytonianum* BRACKENRIDGE, U. S. Expl. Exped. 16 (1854) 252, pl. 36, fig. 3; COPELAND, Trich. (1933) 134, pl. 1, figs. 4-7.

HAWAII.

*Trichomanes Wildii* Bailey seems to belong here.

*VANDENBOSCHIA STENOSIPHON* (Christ) Copeland comb. nov.

*Trichomanes stenosphon* CHRIST, Fedde's Repert. 5 (1898) 10; COPELAND, Trich. (1933) 133, pl. 1, fig. 2.

KOREA.

<sup>22</sup>Ned. Kr. Arch. 5\* (1861) 141.



**VANDENBOSCHIA PARVA** Copeland.*Trichomanes parvum* COPELAND, Trich. (1933) 134, pl. 1, fig. 3.**FORMOSA.****VANDENBOSCHIA SCHMIDIANA** (Zenker) Copeland comb. nov.*Trichomanes Schmidiana* ZENKER, Taschenr. Dissert. (1843) 34, pl. 1, figs. 1, 3, 5; COPELAND, Trich. (1933) 135, pl. 2, fig. 1.**INDIA.****VANDENBOSCHIA PYRIDIFERA** (Lam.) Copeland comb. nov.*Trichomanes pyridiferum* LINNAEUS, Sp. Pl. (1753) 1098; STOSSON, Bull. Torrey Bot. Club 42 (1915) 631.

American Tropics; tropical (?) and South Africa.

I cannot distinguish *T. brasiliense* Desv. from this species.

Several other related "species" are unknown to me.

**VANDENBOSCHIA HYMENOPHYLLOIDES** (v. d. B.) Copeland comb. nov.*Trichomanes hymenophylloides* VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1863) 209; STOSSON, loc. cit.

Tropical America.

*T. borbonicum* van den Bosch, of the East African Islands is, *teste* Christensen, very nearly this species.**VANDENBOSCHIA DIAPHANA** (H. B. K.) Copeland comb. nov.*Trichomanes diaphanum* H. B. K., Nov. Gen. et Sp. 1 (1825) 25.

Tropical South America.

**VANDENBOSCHIA HERZOGII** (Ros.) Copeland comb. nov.*Trichomanes Herzogii* ROSENSTOCK, Meded. Rijks Herb. Leyden No. 19 (1913) 5.**BOLIVIA.****VANDENBOSCHIA SERRATIFOLIA** (Ros.) Copeland comb. nov.*Trichomanes serratifolium* ROSENSTOCK, Hedw. 46 (1906) 77.**BRAZIL.****VANDENBOSCHIA TENERA** (Spr.) Copeland comb. nov.*Trichomanes tenerum* STR., Syst. Veg. IV (1827) 129.

Mexico to Uruguay.

**VANDENBOSCHIA CAPILLACEA** (Linn.) Copeland comb. nov.*Trichomanes capillaceum* LINNAEUS, Sp. Pl. (1753) 1099.

Tropical America.

This and the preceding species are Prantl's section *Leptomanes*. *T. angustatum* Carm., of Tristan d'Acunha, unknown to me, may belong here, may be *Macroglena*, or may be neither.

VANDENBOSCHIA EXSECTA (Kze.) Copeland comb. nov.

*Trichomanes exsectum* KUNZE, Annal. (1837) 47, pl. 29, fig. 2.

SOUTHERN CHILE; JUAN FERNANDEZ.

Like so many far-southern species this is rather isolated in character. Both the lamina and the tube of the involucre are peculiarly marginate.

VANDENBOSCHIA RADICANS (Sw.) Copeland comb. nov.

*Trichomanes radicans* SWARTZ, Schrad. Journ. (1801) 97, Synopsis 143; COPELAND, Trich. (1933) 213, pl. 35, figs. 1, 2.

Tropical America and West Africa, north to Kentucky, Britain, India, and Japan, wanting or nearly so in Malaya and in Polynesia. In my treatise on *Trichomanes* I have reduced to this many supposed Oriental species. Many described American species have been treated in the same way by others. *T. speciosum* Willd., of the Canaries, is a local form probably worthy of specific recognition.

VANDENBOSCHIA SCANDENS (Linn.) Copeland comb. nov.

*Trichomanes scandens* LINNÆUS, Sp. Pl. (1753) 1098.

WEST INDIES.

TRICHOMANES GIGANTEUM Bory.

Bourbon; perhaps local here and in Madagascar; but the name has been given to specimens from Sumatra to Fiji.

VANDENBOSCHIA APHELEBIODES (Christ) Copeland comb. nov.

*Trichomanes aphelebioides* CHRIST, C. Chr., Index (1906) 635; MOLTUM, Journ. Mat. Br. Roy. As. Soc. 6 (1923) 18, pl. 4; COPELAND, Trich. (1933) 219, pl. 38, figs. 5-8.

Sumatra to Fiji.

VANDENBOSCHIA MAXIMA (Blume) Copeland comb. nov.

*Trichomanes maximum* BLUME, Enum. (1828) 228; VAN DEN BOSCH, Hymn. Javan. 26, pl. 18; COPELAND, Trich. (1933) 217, pl. 38, figs. 1-4.

Malaya to Tahiti.

VANDENBOSCHIA JOHNSTONENSIS (Bailey) Copeland comb. nov.

*Trichomanes johnstonense* BAILEY, Proc. Royal Soc. Queensland 1 (1884) 14, lithograms, pl. 26.

QUEENSLAND; PHILIPPINES.

VANDENBOSCHIA DAVALLIODES (Gaud.) Copeland comb. nov.

*Trichomanes davallioides* GAUDICHAUD, Freycinet, Voy. Bot. (1826) 378; COPELAND, Trich. (1933) 215, pl. 36.

HAWAII.

VANDENBOSCHIA CYRTOTHECA (Hilleb.) Copeland comb. nov.

*Trichomanes cyrtotheca* HILLEBRAND, Fl. Haw. (1888) 636; COP-  
LAND, Trich. (1933) 216, pl. 35, figs. 3, 4; pl. 37.

HAWAII.

VANDENBOSCHIA AURICULATA (Blume) Copeland comb. nov.

*Trichomanes auriculatum* BLUME, Enum. (1828) 225; COPLAND, Trich.  
(1933) 223.

*Cephalomanes auriculatum* VAN DEN BOSCH, Hymen. Javan. 34, pl. 25.

Malaya to Japan and Papua.

17. Genus POLYPHLEBIUM Copeland nom. nov.

*Phlebophyllum* VAN DEN BOSCH, Versl. Akad. Wet. Amsterdam 11  
(1861) 321, non *Phlebophyllum* Nees (1832).

Epiphyticum, rhizomate scandente intricato filiforme; frondibus remotis, pendentibus, mediocribus, pinnatifidis vel pinnatis, pinnis plerisque linearibus, rarius lanceolatis pinnatifidisque, membranaceis, costis pinnatim ramosis venulis dichotomis; soris axillaribus, involucre elongato-urceolato, ore expanso, receptaculo gracile longissimo.

An isolated, monotypic genus; the only plant in the family with very thin leaves in which the veins branch freely in undivided segments of the frond. What affinity it has is presumably to the group of *V. pyxidifera*.

Range: New Zealand to Tasmania and Queensland.

#### SPECIES OF POLYPHLEBIUM

POLYPHLEBIUM VENOSUM (R. Br.) Copeland comb. nov. Plate 7.

*Trichomanes venosum* R. BROWN, Prod. Fl. N. Holland (1810) 159;  
COPLAND, Trich. (1933) 188.

18. Genus PLEUROMANES Presl

*Pleuromanes* PREST, Epim. Bot. (1849) 258.

*Leucomanes* PREST, ibid.

*Craspedaneuron* VAN DEN BOSCH, Synopsis (1859) 21, as section; Hy-  
men. Javan. (1861) 32, as genus.

Typice epiphytica, rhizomate filiforme late repente et intricato, molliter piloso; stipitibus remotis gracillimis; frondibus pendentibus glaucis, majusculis, bi-tripinnatifidis, segmentis linearibus margine incrassato, strato sclerenchymatico costam circumdante dilatato, parte mediale segmenti ideo crassa et opaca, molliter pilosa; soris axillaribus, involucris urceolatis ore aut truncato aut subexpanso, receptaculo filiforme valde protruso.

A small, well-marked genus, derived from *Vandenboschia latifrons*, a relative of *V. pyxidifera*. In my paper on *Trichomanes*

I treated *T. latifrons* as a member of the daughter group; but, as a matter of convenient verbal definition, it is necessary to leave it in the parent genus. As to the margin, cf. Copeland, Hymen. (1937) pl. 10, and Mettenius, pl. 1, fig. 23.

Range: Ceylon and Luzon to Tahiti. *V. latifrons* is found from the Himalayas to Formosa and Luzon.

#### SPECIES OF PLEUROMANES

##### PLEUROMANES ACUTUM Presl.

*Trichomanes acutum* Presl., Hymen. 133; COPELAND, Trich. (1933) 140.

LUZON. The type species.

##### PLEUROMANES PALLIDUM (Blume) Presl.

*Trichomanes pallidum* BLUME, Koenig. 225; COPELAND, Trich. (1933) 141.

The range of the genus.

#### 19. Genus GONOCORMUS van den Bosch

*Gonocormus* VAN DEN BOSCH, Hymen. Javaa. (1861) 7; Eerste Bijdrage (1861) 221.

Rhizomate et stipite vix vel tantum distinguendis, tenuibus, obscuris, rigidis, apice stipitis typice prolifera; frondibus minutis, venatione flabellata, margine inciso, parietibus non villatis; involucribus immersis tubiformi-campanulatis ore conspicue dilatatis, receptaculo exserto.

A well-defined genus of exceedingly ill-defined species, ranging from Africa across Polynesia and to Japan.

The first publication of the generic name was not accompanied by a diagnosis, but it is authenticated by described species of which the first is *G. minutus* (*Trichomanes minutum* Bl.). A diagnosis was published in the same year. I have discussed this group in sufficient detail in my treatise on *Trichomanes*.<sup>33</sup> The Marquesan specimen, *Mumford and Adamson 861*, which<sup>34</sup> I regarded as *T. parvulum*, is *T. latilabiatum* E. Brown.<sup>35</sup> Christensen<sup>36</sup> believes that *T. parvulum* Poir. is really the plant since called *T.* (or *Hymenophyllum*) *sibthorpioides*, and suggests that the widespread species of *Gonocormus* would better be called *T.*

<sup>33</sup> 142 ff.

<sup>34</sup> This issue, p. 106.

<sup>35</sup> Bishop Mus. Bull. 89 (1931) 8, fig. 3.

<sup>36</sup> Pterid. Madagascar (1932) 3.

*saxifrugoides* Presl. An older name is *T. minutum* Blume, from which I do not consider *T. saxifrugoides* genetically distinct.

If species are to be distinguished in *Gonocormus*, they may be:

*G. minutus* (Blume) v. d. Bosch, using this name for what has been called *T. parvulum*; the range of the genus.

*G. diffusus* (Blume) v. d. Bosch.

*G. prolifer* (Blume) Prantl, exemplifying the genus in its most characteristic development.

*G. Teysmanni* v. d. Bosch.

*GONOCORMUS ALAGENSIS* (Christ) Copeland comb. nov.

*Trichomanes alagensae* CHRIST, Philip. Journ. Sci. § C 3 (1908) 270;

Copeland, Trich. (1933) 152, pl. 6, figs. 4-7.

PHILIPPINES. More distinct than are most of these species.

*GONOCORMUS LATILABIATUS* (E. Brown) Copeland comb. nov.

*Trichomanes latilabiatum* E. BROWN, Bishop Mus. Bull. No. 89 (1931) 8, fig. 3.

MARQUEEAS.

29. Genus *CREPIDOPTERIS* Copeland nom. nov.

*Trichomanes*, § *Crepidium* PRESL, Hymen. (1843) 115, non *Crepidium* Blume (1825).

*Crepidomanes* VAN DEN BOSCH, Hymen. Javan. (1861) 16, non Presl.

Aut epiphyticae aut terrestres, rhizomate gracile late repente, frondibus remotis minusculis, typice bipinnatifidis, rhachi alata, venulis spuris nullis; cellulis marginalibus 1- vel 2-seriatis valde elongatis parietibus varie incrassatis, cellulis aliis isodiametricis parietibus tenuibus; soris segmenta acropetalia infima occupantibus, involucris infundibuliformibus alatis ore patente, receptaculo profruso.

Typus: *C. humilis* (Forster sub *Trichomane*).

A small, well-defined genus of the Malay-Polynesian region, regarded as a relative of the group of *Vandenboschia pyxidifera* for want of other evident affinity; probably not nearly related to *Crepidomanes* with which it has been confused. The longitudinally elongate marginal cells are a convenient diagnostic characteristic, but the genus is recognizable at sight by a combination of characters—small size, thinness, narrowly elliptic form, degree of dissection, position of sori—which are not individually diagnostic. If two rows of cells are elongate, the inner row may be double in thickness (two cells deep).

## SPECIES OF CREPIDOPTERIS

CREPIDOPTERIS HUMILIS (Forster) Copeland comb. nov.

*Trichomanes humile* FORSTER, Prod. (1780) 12; COPELAND, Trich. (1933) 164, pl. 12.

Sumatra to Tahiti, not to New Zealand.

CREPIDOPTERIS GRACILLIMA Copeland.

*Trichomanes gracillimum* COPELAND, Trich. (1933) 168, pl. 13.

LUZON.

CREPIDOPTERIS ENDLICHERIANA (Presl) Copeland comb. nov.

*Trichomanes endlicherianum* PRESL, Epim. Bot. (1849-51) 10, pl. 5A; COPELAND, Trich. (1933) 168, pls. 14, 15.

New Zealand to Norfolk, Fiji, and Tahiti.

CREPIDOPTERIS WERNERI (Rosenst.) Copeland comb. nov.

*Trichomanes Werneri* ROSENSTOCK, Fedde's Repert. 5 (1908) 35; COPELAND, Trich. (1933) 170, pl. 16.

NEW GUINEA.

CREPIDOPTERIS VIEILLARDII (v. d. B.) Copeland comb. nov.

*Trichomanes Vieillardii* VAN DEN BOSCH, Ann. Sc. Nat. IV 15 (1861) 90; COPELAND, Trich. (1933) 171, pl. 17.

NEW CALEDONIA.

## 21. Genus CREPIDOMANES Presl

*Crepidomanes* PRESL, Epim. Bot. (1851) 258.*Tasekneria* PRESL, *ibid.*; COPELAND (as group), Trich. (1933) 174.

Cellulae parenchymatis magnae, seriales, rotundato-hexagonoidae, interibus crassiusculis. Venae venulaeque distantes, simplices, costis conformes. Venula infra-marginalis tenuis, continua. Reliqua ut in *Eutrichomane*.—PRESL, *loc. cit.* (etiam p. 17).

Epiphytica rarius terrestria, rhizomate filiforme late repente, piloso, radicibus saepe vel semper carentibus; frondibus medio-cribus pinnatim dissectis (vel reductis digitatis), axibus plerisque alatis, segmentis angustis monophlebiis, margine integro nudo, striis sclerenchymaticis aut intramarginalibus aut irregulariter dispersis nunquam carentibus; soris typice axillaribus (paratactis), involuero obconico, vel campanulato, vel infundibuliforme, alato, ore bifido (rarissime symmetrice evoluto), receptaculo exserto.

An Old World genus of a dozen or more species ranging from the East African Islands to Japan and Polynesia. The striae

afford a convenient and sure diagnostic character, and the mouth of the involucre is bilabiate with the single exception of *C. Christi*. This combination of characters has been regarded as sufficient to establish affinity to *Didymoglossum*, with which this group was combined by van den Bosch. Prantl then restricted the application of the name *Didymoglossum* to this group, and renamed the real *Didymoglossum* as *Hemiphlebium*. Actually it is not *Didymoglossum*, but *Microgonium*, which has immediate affinity to *Crepidomanes*. Because *Microgonium* is evidently a group of reduced species, *Crepidomanes* is likely to have been the parent genus. I have thought<sup>57</sup> that *Crepidomanes* was "presumably derived from the group of *T. pyxidiferum*," but am now as ready to share van den Bosch's view that it represents a coordinate evolutionary line, with some ultimate affinity to *Didymoglossum*. I do not believe, however, that the bilabiate mouth of the involucre betrays any real near affinity to *Hymenophyllum*.

The species are locally variable, and dwarfing is common. The series of dwarfs of various species converges with reduction, until the more extreme dwarfs of diverse origin tend to become indistinguishable. *T. Lenormandi*, which I list under *Microgonium*, is evidently a very reduced *Crepidomanes*.

#### SPECIES OF CREPIDOMANES

**CREPIDOMANES INTRAMARGINALE** (H. and G.) Copeland comb. nov.

*Trichomanes intramarginale* Hooker and Greville, *Copeland, Trich.* (1933) 189, pl. 23, figs. 1-3.

CEYLON; INDIA. The type species of the genus.

**CREPIDOMANES BIPUNCTATUM** (Poiret) Copeland comb. nov.

*Trichomanes bipunctatum* POIRET, *Lam., Enc. 3* (1808) 60; *Copeland, Trich.* (1933) 177, pl. 18, figs. 1-4.

Madagascar to Tahiti, with a gap in Malaya.

**CREPIDOMANES BILABIATUM** (Nees and Blume) Copeland comb. nov.

*Trichomanes bilabiatum* NEES and BLUME, *Nova Acta 14* (1823) 123, pl. 13, fig. 2; *Copeland, Trich.* (1933) 179, pl. 18, figs. 5, 6.

JAVA; SUMATRA.

**CREPIDOMANES RUPICOLUM** (Rachib.) Copeland comb. nov.

*Trichomanes rupicolum* RACHORSKI, *Pterid. Buitenzorg* (1898) 24; *Copeland, Trich.* (1933) 181, pl. 19, fig. 2.

JAVA.

<sup>57</sup> *Trich.* (1933) 174.

**CREPIDOMANES BREVIPES** (Presl.) Copeland comb. nov.*Didymoglossum brevipes* Presl, Hymen, (1842) 139.*Trichomanes brevipes* BAKER, Syn. Fil. 84; COPELAND, Trich. (1933) 182, pl. 20.

PHILIPPINES; GUAM; BORNEO.

**CREPIDOMANES CHRISTII** Copeland.*Trichomanes Christii* COPELAND, Philip. Journ. Sci. 1 (1906) Suppl. 231; Trich. (1933) 185, pl. 21.

Philippines to Sumatra.

**CREPIDOMANES VENULOSUM** (Rosenst.) Copeland comb. nov.*Trichomanes bipunctatum* var. *venulosa* ROSENSTOCK, Hedwigia 56 (1915) 250.*Trichomanes venulosum* COPELAND, Trich. (1933) 186, pl. 22, figs. 1, 2.

NEW GUINEA.

**CREPIDOMANES NYMANI** (Christ) Copeland comb. nov.*Trichomanes Nymanii* Christ, Schum. and Laut., Flora Südsee Nachtr. (1906) 36; COPELAND, Trich. (1933) 187, pl. 19, fig. 4.

NEW GUINEA.

**CREPIDOMANES PERVENULOSUM** (v. A. v. K.) Copeland comb. nov.*Trichomanes pervenulosum* v. A. v. ROSENBERGH, Philip. Journ. Sci. § C 11 (1910) 103, pl. 5, fig. 2; COPELAND, Trich. (1933) 188, pl. 19; pl. 20, fig. 3.

AMBOINA.

**CREPIDOMANES LATEMARGINALE** (Eaton) Copeland comb. nov.*Trichomanes latemarginale* EATON, Proc. Am. Acad. 4 (1859) 111; COPELAND, Trich. (1933) 189, pl. 24.

India to Formosa.

**CREPIDOMANES MEGISTOSTOMUM** Copeland.*Trichomanes megistostomum* COPELAND, Trich. (1933) 191, pl. 23, figs. 4-6.

SIAM.

**CREPIDOMANES LATELATUM** (v. d. B.) Copeland comb. nov.*Trichomanes latealatum* VAN DEN BOSCH, Ned. Kruid. Arch. 5\* (1863) 138; COPELAND, Trich. (1933) 192, pls. 25, 26.

INDIA.

There may be a considerable number of additional species in the Indo-Sino-Japanese region. More than a dozen have been named. I have seen authentic material of half of them and, comparing type collections only, would deem them distinct enough. Among most plants this would be a satisfactory test of specific



identity. In this particular group, however, the characteristics embodied in the descriptions are subject to such wide variation, that I prefer not to risk encumbering synonymy with new combinations of names until the examination of many collections may show that the several supposed species do not too freely overlap as they vary. The examination of very many collections has shown that a number of "species" described from the Philippines and Java, apparently distinct if the types only are compared, are forms of the fairly protean *C. brevipes* and *C. bilabiatum*.

## 22. Genus MICROGONIUM Presl

*Microgonium* PRESL, Hymen. (1843) 111; VAN DEN BOSCH, Hymen. Javan. 5.

*Hemiphibium* § *Microgonium* PRANTL, Hymen. 43.

Type epiphytica, rhizomate filiforme, intricato, velutino, radicibus saepe vel semper carentibus; frondibus remotis, minimis, integris vel lobatis, margine nudo, venatione flabellata vel pinnata, venulis spuris praeditis, venatione planis; soris epitactis marginalibus, involucre elongato, ore expanso vix bilabiato, receptaculo extruso.

Range: Old World Tropics, one species apparently American. Evidently derived, by reduction, from *Crepidomanes*.

### SPECIES OF MICROGONIUM (SUBMARGINAL STRAND PRESENT)

#### MICROGONIUM BIMARGINATUM van den Bosch.

*Microgonium bimarginatum* VAN DEN BOSCH, Hymen, Javan (1861) 7.

*Trichomanes bimarginatum* VAN DEN BOSCH (1861); COPELAND, Trich. (1933) 208, pl. 33, figs. 1-4.

Malaya to Ceylon and Samoa.

#### MICROGONIUM MINDORENSE (Christ) Copeland comb. nov.

*Trichomanes mindorense* CHRIST, Philip. Journ. Sci. § C 3 (1908) 270; COPELAND, Trich. (1933) 209, pl. 34, figs. 1, 2.

MINDORO.

#### MICROGONIUM CRASPEDONEURUM Copeland.

*Trichomanes craspedoneurum* COPELAND, Philip. Journ. Sci. § C 7 (1912) 53; Trich. (1933) 208, pl. 33, figs. 5-7.

LUZON.

#### MICROGONIUM CUSPIDATUM (Willd.) Presl.

*Microgonium cuspidatum* (Willd.) PRESL, Hymen. 111, pl. 6A, the type of the genus.

*Trichomanes cuspidatum* WILLDENOW, Copeland, Trich. (1933) 210, pl. 32, figs. 6, 7.

East African Islands.

**MICROGONIUM CROSUM** (Willd.) Presl.

*Trichomanes crasum* WILDENOW, Copeland, Trich. (1933) 219, pl. 34, figs. 3-6.

**AFRICA.**

*Trichomanes lenormandi* v. d. Bosch, of the Comores and Madagascar, belongs here by the original description; and *T. pygmaeum* C. Chr. clearly does so by definition.<sup>28</sup> But Christensen suspects that they are one species. And *T. Lenormandi* in its larger forms would better be regarded as a reduced *Crepidomanes*.

Related to this, but without any marginal vein, are *T. fulgens* C. Chr. and *T. Kirkii* Hooker, of the same region.

**MICROGONIUM HOOKERI** Presl.

*Microgonium hookeri* PRESL. (1848).

*Trichomanes hookeri* PRESL., Hymen. 108, non *Didymoglossum hookeri* PRESL., ibid. 115.

*Microgonium bertcroanum* PRESL., ibid. 112 nomen, 138, pl. 62.

Cuba to Guiana. Submarginal strand absent.

**MICROGONIUM SUBLIMBATUM** (K. Müller) van den Bosch.

*Microgonium sublimbatum* (K. Müller) VAN DEN BOSCH, Hymen. Javan. 6, pl. 2.

*Trichomanes sublimbatum* K. MÜLLER, Copeland, Trich. (1933) 198, pl. 28, figs. 1, 2.

Assam to Papua.

**MICROGONIUM KENZAIANUM** (Parish) Copeland comb. nov.

*Trichomanes kenzaiatum* PARISH in Hooker, Second Cent. Ferns (1890) pl. 1; COPELAND, Trich. (1933) 198, pl. 28, figs. 3, 4.

*Microgonium kenzaiense* VAN DEN BOSCH.

MOULMEIN (or Tenasserim).

The involucre is obconic, but the false veins leave little doubt that this is a *Microgonium*.

**MICROGONIUM MOTLEYI** van den Bosch.

*Microgonium motleyi* VAN DEN BOSCH, Hymen. Javan. 5, pl. 1.

*Trichomanes motleyi* VAN DEN BOSCH, Copeland, Trich. (1933) 201, pl. 30, figs. 1-4.

BORNEO; MALAY PENINSULA; further range doubtful.

<sup>28</sup> Bonaparte, Notes Pterid. 12 : 13, pl. 10; Pterid. Madag. 2: figs.

**MICROGONIUM BECCARIANUM** (Cesati) Copeland comb. nov.

*Trichomanes beccarianum* CESATI, Atti Accad. Napoli 7 pt. 8 (1876)  
8, pl. 1, fig. 2; COPELAND, Trich. (1933) 200, pl. 20.

Ceylon to Formosa and the Solomon Islands.

The key, p. 197, of my treatise on *Trichomanes*, is in error as to this species, but the latter is correctly distinguished from *T. cultratum* in the text.<sup>39</sup>

**MICROGONIUM CULTRATUM** (Baker) Copeland comb. nov.

*Trichomanes cultratum* BAKER, Journ. Bot. 17 (1879) 293; COPELAND,  
Trich. (1933) 202, pl. 30, figs. 5-7.

Fiji; QUEENSLAND.

**MICROGONIUM OMPHALODES** Viellard.

*Microgonium omphalodes* VIELLARD.

*Trichomanes omphalodes* C. Chr., COPELAND, Trich. (1933) 203, pl. 31,  
figs. 1-6.

*Trichomanes peltatum* BAKER (non Poiret) Journ. Linn. Soc. 9 (1866)  
336, pl. 80; GIESSENHAGEN, Hymen., figs. 14-26.

Java to Tahiti.

*Hymenophyllum parvifolium* Baker, Moulmein, was described by both Baker and Kuhn as having striae, but no veins except the costae. It may be a very small *M. henzeianum*.

*Trichomanes Hildebrandtii* Kuhn, from the Comores, apparently collected only once, and scantily, is superficially very like *M. omphalodes*; it is larger, but *M. omphalodes* is variable in size. I have specimens of *M. omphalodes* more than 25 mm in diameter, although 10 mm is a commoner size. The known range being from Tahiti to Java, extension to the African islands would not be surprising. However, Giesenhagen<sup>40</sup> has found, beside minor differences, that the lamina of *T. Hildebrandtii* is several cells thick, with the chlorophyll confined to the upper superficial layer. It is, of course, no *Trichomanes*, in my use of that name; but, without a specimen, I do not know whether or not it is a *Microgonium*.

In my treatises on *Trichomanes* and on *Hymenophyllum* I have had repeatedly to emphasize the fact that simplification in form, and eventually in structure, is a natural concomitant of reduction in size; and that, in the course of simplification, the characteristics which indicate affinity and ancestry may more

<sup>39</sup> Pages 202, 203.

<sup>40</sup> Hymen. 449-452, figs. 1, 5.

or less completely disappear, with the result that reduced plants of diverse ancestry may be very much alike.

In *Didymoglossum* and *Microgonium* we are dealing with plants as reduced as we know in the family; and must recognize the fact that so far as the group of characters which have commonly served for specific diagnosis are concerned, descendants of almost any larger plants of the old genus *Trichomanes*, reduced to this point, might be regarded as conspecific. *Trichomanes muscoides* has been construed broadly and variously enough to illustrate this fact. Recognizing the difficulty of detecting real affinity among such reduced plants, I intended first to combine them, as *Didymoglossum*, and avow lack of confidence in the unity of such a genus. In particular the Oriental species have looked like derivatives of *Crepidomanes* (*Tuschnetia*), which is confined to the Old World, and I have hesitated to regard a pantropic group as derived from one of limited range and, therefore, presumably younger.

Study of the available American material, representing the generally accepted species, has now shown that they have a common significant character, in the possession of marginal setae, which are wanting on all species of the Malay-Polynesian region. On the strength of this distinction, already emphasized by Prantl,<sup>1</sup> I now regard the Oriental group, without setae, as genetically distinct, and related to *Crepidomanes*, which has much the same range. *Microgonium Hookeri* is the only species falling outside this geographic range, and I may be in error in including it; it may be a very aberrant member of *Didymoglossum*. However, the expanded, nonbilabiate involucre of *D. Petersii* arouses no doubt as to its affinity, any more than does the symmetrically expanded mouth of *Crepidomanes Christi*, in a genus otherwise characterized by somewhat bilabiate mouths.

23. Genus CALLISTOPTERIS Copeland gen. nov.

Epiphyticae, rhizomate valido adscendente; stipitibus caespitosis, teretibus, setosis; frondibus magnis, basi plus minus angustatis, quadripinnatifidis segmentis linearibus tenuiter membranaceis; parietibus tenuibus; involucribus immersis, obconicis, ore truncato vel subbilabiato, receptaculo exserto.

Typus: *C. apiifolia* (Presl sub *Trichomane*).

<sup>1</sup> Hymen. 46.

A small, well-marked group, the showiest in the family.  
Range: Malaya across Polynesia.

## SPECIES OF CALLISTOPTERIS

**CALLISTOPTERIS APIIFOLIA** (Presl) Copeland comb. nov.

*Trichomanes apiifolium* PRESL, Hymen. (1843) 108, 136; VAN DEN BOSCH, Hymen. Javan. 26, pl. 19; COPELAND, Trich. (1933) 227, pl. 42, fig. 1.

Sumatra to Samoa.

**CALLISTOPTERIS BAUCERIANA** (Endl.) Copeland comb. nov.

*Trichomanes baucianum* ENDLICHER, Prod. Fl. Norfolk (1833) 17; COPELAND, Trich. (1933) 229, pl. 42, fig. 2.

NORFOLK; LORD HOWE ISLAND.

**CALLISTOPTERIS POLYANTHA** (Hooker) Copeland comb. nov.

*Hymenophyllum polyanthum* HOOKER, Nightingale, Oceanic Sketches (1835) 132.

*Trichomanes polyanthum* Hooker, COPELAND, Trich. (1933) 230, pl. 42, fig. 3.

*Trichomanes societense* J. W. MOORE, Bishop Mus. Bull. 102 (1933) 5.

SOCIETY ISLANDS.

**CALLISTOPTERIS BALDWINII** (Eaton) Copeland comb. nov.

*Hymenophyllum Baldwinii* EATON, Bull. Torr. Bot. Club 6 (1879) 203.  
*Trichomanes Baldwinii* COPELAND, Trich. (1933) 230, pl. 42, figs. 4-8.

HAWAII.

## 24. Genus NESOPTERIS Copeland gen. nov.

Terrestres, rhizomate valido suberecto, stipitibus caespitosis, longis, sursum anguste alatis ala decidua; frondibus magnis, quadripinnatifidis, basi vix angustatis, segmentis linearibus, costis pilis minutis clavatis obsitis; cellulis parvis, parietibus tenuibus rectis, involucri cylindricis alatis, receptaculis exsertis.

Typus: *N. grandis* (Copel. sub *Trichomanes*).

A small, well-marked genus, superficially somewhat like *Sele-nodesmium*, with larger, less rigid, more finely dissected fronds, and very different structure. More like *Callistopteris*, from which it differs in the firmer texture, in habitat, pubescence, and

<sup>2</sup> This name is proposed on the ground that "*polyanthum*" is an orthographic variant of "*polyanthus*" which I do not believe. The Greek equivalent of "*polyanthus*" is "*polyanthes*." If Swartz had used that word, it would invalidate Hooker's specific name. Swartz made up his word; I am not sure what it is, but take it to be a noun used as an adjective. And a noun and an adjective are not orthographic variants.

shape of involucre. The three seem to be phyletically distinct, probably independently related to (derived from) the group of *Vandenhoschia radicans*. *V. maxima* represents more definitely the source of *Nesopteris*.

Range: Loochoo and Java to Samoa; unknown on the continent, and hence named the island fern.

\* SPECIES OF NESOPTERIS

NESOPTERIS GRANDIS Copeland.

*Trichomanes grande* COPELAND, Philip. Journ. Sci. § C 6 (1911) 70;

Trich. (1933) 224, pl. 40, figs. 1-4.

*Trichomanes prestianum* NAKAI, Bot. Mag. Tokyo 40 (1926) 261.

PHILIPPINES; JAVA.

NESOPTERIS THYSANOSTOMA (Makino) Copeland comb. nov.

*Trichomanes thysanostomum* MAKINO, Bot. Mag. Tokyo 12 (1898) 193 nomen; 13 (1899) 46.

*Trichomanes blepharistomum* COPELAND, Trich. (1933) 225, pl. 41.

LOOCHOO; LUZON.

NESOPTERIS INTERMEDIA (v. d. B.) Copeland comb. nov.

*Trichomanes intermedium* VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861)

179; Journ. Bot. Neerl. 1 (1861) 361; COPELAND, Trich. (1933)

226, pl. 40, fig. 5.

PAPUA; POLYNESIA.

NESOPTERIS SUPERBA (Backhouse) Copeland comb. nov.

*Trichomanes superbum* BACKHOUSE, Moore, Gard. Chron. (1862) 44;

COPELAND, Trich. (1933) 221, pl. 39.

BORNEO.

25. Genus CEPHALOMANES Presl

*Cephalomanes* PRESL, Hymen. (1843) 100, pl. 5.

Venae pinnatim exsertentes, creberrimae, prominulae, uni- bifurcatae, venulisque sterilibus apice obtuso liberae. Sorus in dentibus frondis oblitteratis terminalis, pedicellatus. Indusium cylindraceum, limbo patente integro. Receptaculum indusio dimidio duplove longius, rectum, rigidulum, cylindricum, apice in globum incrassatum, basi capsuliferum. Capsulae sessiles, lenticulares.

Species. *Cephalomanes atrovirens*.—PRESL, loc. cit.

Terrestre, rhizomate valido adscendente vel erecto, radicibus validis obscuris sustenso; stipilibus dense fasciculatis, setosis, rigidis; fronde plerumque lanceolata, simplice pinnata, obscura, rigidula, venis crassis saepe in dentes vel lacinias ultra marginem protensis; cellulis magnis, parietibus in proportionem tenuibus, undulatis; involucri cylindricis (rarius obconicis) rigidis, receptaculo crasso longe exserto.

A small and very natural genus of the Oriental Tropics, derived from the group of *Vandenboschia radicans*. *V. auriculata*, which I leave in the latter group, but which van den Bosch treated as *Cephalomanes*, illustrates the course of evolution of the daughter genus. The globose tip of the receptacle, responsible for the generic name, was illusory or very exceptional, although Presl depicted it for a second species, *C. oblongifolium*.<sup>23</sup>

Range: Malaya to India and across Polynesia.

#### SPECIES OF CEPHALOMANES

**CEPHALOMANES JAVANICUM** (Blume) van den Bosch.

*Cephalomanes javanicum* VAN DEN BOSCH, Hymen. Javan. 30, pl. 22.

*Trichomanes javanicum* Blume, COPELAND, Trich. (1933) 246, pl. 52, fig. 1.

Java to India (and Papua?).

**CEPHALOMANES SINGAPORIENSEM** van den Bosch.

*Cephalomanes singaporiense* VAN DEN BOSCH, Synopsis (1859) 11.

*Trichomanes singaporiense* v. A. v. ROSENBERGH, COPELAND, Trich. (1933) 247, pl. 52, fig. 5.

SINGAPORE; MALAY PENINSULA; BORNEO.

**CEPHALOMANES SUMATRANUM** (v. A. v. R.) Copeland comb. nov.

*Trichomanes sumatranum* v. A. v. ROSENBERGH, Bull. Dept. Agr. Ind.

Neerl. No. 18 (1908) 4; COPELAND, Trich. (1933) 248, pl. 52, fig. 4.

SUMATRA; BORNEO; ANNAM.

**CEPHALOMANES OBLONGIFOLIUM** Presl.

*Cephalomanes oblongifolium* PRESL, Epim. Bot. 19, pl. 10.

*Trichomanes asplenoides* PRESL, Hymen. (1843) 129, non Swartz; KUNZE, Farnkr. 218, pl. 89; COPELAND, Trich. (1933) 249, pl. 52, fig. 2; pl. 55, fig. 10.

PHILIPPINES; AMBOINA; BORNEO; FORMOSA; SOLOMON ISLANDS.

**CEPHALOMANES ATROVIRENS** Presl.

*Cephalomanes atrovirens* PRESL, Hymen. (1843) 110, pl. 5, the generic type.

*Trichomanes atrovirens* Kunze, COPELAND, Trich. (1933) 251, pl. 52, fig. 3; pl. 55, fig. 2.

PHILIPPINES; NEW GUINEA; QUEENSLAND.

**CEPHALOMANES DENSINERVIVM** Copeland.

*Trichomanes densinervium* COPELAND, Philip. Journ. Sci. § C 6 (1911)

71; Trich. (1933) 253, pl. 53, fig. 1.

NEW GUINEA.

<sup>23</sup> Epim. Bot., pl. 10.

## CEPHALOMANES KINGII Copeland.

*Trichomanes Kingii* COPELAND, Philip. Journ. Sci. § C 6 (1911) 72;  
Trich. (1933) 253, pl. 53, fig. 2.

## NEW GUINEA.

## CEPHALOMANES ACROSORIUM Copeland.

*Trichomanes acrosorium* COPELAND, Philip. Journ. Sci. § C 6 (1911)  
72; Trich. (1933) 254, pl. 53, fig. 3.

## NEW GUINEA.

## CEPHALOMANES BORYANUM (Kunze) van den Bosch.

*Cephalomanes boryanum* VAN DEN BOSCH, Synopsis (1859) 11.

*Trichomanes boryanum* KUNZE, Parnkr. 237, pl. 97; COPELAND, Trich.  
(1933) 254, pl. 52, fig. 4.

## POLYNESIA.

*Cephalomanes madagascariense* van den Bosch, Synopsis 11,  
is a doubtful species; cf. Christensen, Pterid. Madagascar  
(1932) 5.

*Trichomanes Foersteri* Rosenstock, of Sumatra, is unknown to  
me.

*Trichomanes crassum* Copel.<sup>41</sup> is certainly *Cephalomanes*, but,  
being known sterile only, may be suspected of being hybrid or  
monstrous. LEYTE (Philippines).

## 25. Genus TRICHOMANES Linnaeus

*Trichomanes* LINNÆUS, Sp. Plant. (1753) 1037.

*Trichomanes* § *Achomanes* PREST, Hymen. (1843) 105.

*Rugatulus* PRESL, Hymen. (1843) 105.

*Neurophyllum* PRESL, Hymen. (1843) 110, non Torrey et Gray.

*Odontomanes* PRESL, Epim. Bot. (1849) 16.

*Neuromanens* THURVIAN (1851); VAN DEN BOSCH, Synopsis 7.

*Ptilophyllum* VAN DEN BOSCH (1861); PRANTL, *partim*; non Morris nec  
aliorum.

*Lacosteia* VAN DEN BOSCH (1861); PRANTL, *pro parte minus*.

Although the era of our botanic nomenclature began with the  
publication of Linnaeus' *Species Plantarum* in 1753, genera are  
not defined in that work. For Linnaean generic definitions and,  
therefore, for the typification of his genera, we must go to earlier  
works of the same author.<sup>42</sup> In the case of *Trichomanes* it is

<sup>41</sup> Trich. (1933) 256, pl. 54; pl. 55, fig. 3.

<sup>42</sup> The latest rule sends us to the next subsequent edition of the "Genera,"  
but, to interpret the definition found there, we must still go back to the  
first edition, where the same definition is amplified by references which fix  
the type.



defined in the *Corollarium Genera Plantarum* (and, *teste* Underwood, in *Hortus Cliffortianus*, also dated 1937): "Calyx turbinatus, solitarius, erectus, ex ipso margine folii. Stylus setaceus capsulam terminans." No species is mentioned, but reference is made to Plumier<sup>10</sup> for an illustration. This is *Trichomanes crispum*. As Linnaeus's generic concept finds its first expression here, and no other species is mentioned or referred to, this species must be accepted as the type species of the genus.

The genus typified by this species may be a small but natural one, pinnatifid or simply pinnate, mostly bearing long, soft hairs, with rather close veins tending to be parallel, restricted to the American Tropics, being then Presl's section *Achomanes*, van den Bosch's and Prantl's genus *Ptilophyllum*; or it can be a much larger, still natural, genus, including a number of such more or less definable groups, and found in all moist tropical and most warm-temperate regions. I use it in the former sense and diagnose it accordingly:

Typically terrestrial American ferns; fronds typically uniform, pinnatifid to pinnate in plan, false veinlets rarely present, and then between and parallel to the veins, lamina one cell thick except immediately along veins; involucre obconic to cylindric, the mouth truncate to expanded, but not valvate or bilabiate, receptacle slender and protruding; sporangia rather small, and with a limited number of wall cells.

That *T. crispum* is not congeneric with *T. scandens* L., *T. radicans* Sw., and *T. pygidiferum* L. has been the belief of nearly every author who undertook to break the huge group called *Trichomanes* in the general treatises on ferns into smaller, natural genera. By the principles of the typification of genera now generally accepted, van den Bosch and Prantl erred in keeping the name for the larger, more primitive, cosmopolitan group of *T. radicans*, and introducing a new name, *Ptilophyllum*, for *Trichomanes* as properly typified. To this extent they had justification, that they left in *Trichomanes* the larger number of species. If, however, they had observed any rule at all, they would have adopted, for the group including *T. crispum*, Presl's name *Rogatelas*, based on the nearly related *T. crinitum*, in spite of the fact that Presl erected the genus on an erroneous figure and without seeing the plant. Presl based *Cephalomanes* on an equally baseless or imaginary character; but van den Bosch re-

<sup>10</sup> Fil. 86.

tained that genus and quoted Linnæus in justification: "Nomen genericum dignum alio, licet aptiore, permutare non licet."<sup>17</sup>

To place some limit on the number of new binomials which have to result from the typification of the genus by *T. crispum*, I have construed it as broadly as I could—except as it might include *Feca*. *Odontomanes* might, about as reasonably as *Feca*, be given generic status; the group is natural and definable, but its affinity to *T. crispum* is reasonably clear. And, if one would give generic status to every definable and apparently natural group, *Neuromanes* could be recognized, along with *Odontomanes*.

The reduction of *Ptilophyllum* and *Lacosteia* to one genus is a somewhat different proposition. Van den Bosch and Prantl, who are responsible for both, were careful students of these ferns. Prantl laid particular stress on the system of branching and the position of the sori. Subordinating all other considerations to these, he divided the great group which might be called *Trichomanes*, after the elimination of such more clearly distinct, smaller, related groups as *Didymaglossum* (in the sense of Desvaux), into *Ptilophyllum*, *Lacosteia*, and *Trichomanes*, the latter including *T. pyxidiferum* and *T. radicans*. Prantl's criteria are useful in some groups of ferns, but not here. *Lacosteia* was to be characterized by anadromic venation and paratact sori, in distinction to *Ptilophyllum*, and limited dissection of the frond, in distinction to *Trichomanes*. He included in it *T. javanicum*, not knowing *T. asplenoides* Presl (properly *Cephalomanes oblongifolium*), which even until Christensen has been reduced to *T. javanicum*, although its sori are epitact. Among American species both van den Bosch and Presl placed *T. olatum* (as *P. ptilodes*) in *Ptilophyllum*, although to me it seems clearly to be close to *Lacosteia* (*T. pedicellatum*); and also to *T. luschnatianum* (*T. rupestre*) which they left in *Trichomanes*. At this point, though, we come to what I regard as a likely genetic connection between my *Trichomanes* and that of Prantl, so that one has reasonable freedom of choice as to where he will leave *T. rupestre*.

Another character of generic value in many cases is the elongation of the rhizome, commonly correlated with the remoteness of the leaves, and with their arrangement, as distichous or polystichous. However good a generic character in many or

<sup>17</sup> Synopsis 10.

most groups, it is not even a specific character in others—*T. meifolium*, for example. In *Trichomanes* it will not serve even for natural subgeneric grouping. In the family in general the elongate rhizome is primitive. Regarding *Vandenboschia* as ancestral to *Trichomanes*, I suggest *T. rupestre* as a primitive element in *Trichomanes*, as shown by both the slender, elongate rhizome and the dissection of the frond. But it does not appear that all species with clustered fronds, or all species with elongate rhizomes, constitute a natural group. Both types of rhizome appear even in *Ficca*, derived from a *Trichomanes* group in which most of the species have the fronds clustered on a sub-erect rhizome.

Another feature of generic value in many cases, but not here, is hairiness, as hairs may be absent on the lamina, or present and of particular form. Most species of section *Ptilophyllum* bear long, weak hairs. This character is unstable also in *Vandenboschia* and *Ficca*.

Range: Tropical America, extending a little beyond the Tropics.

#### SPECIES OF TRICHOMANES

Fronds bipinnatifid; Approximately *Lacosten* van den Bosch.

TRICHOMANES RUPESTRE (Raddi) van den Bosch.

Tropical South America.

*T. venustum* Desv. is a more divided form, from Central America.

TRICHOMANES ANKERII Parker.

Trinidad to Brazil.

TRICHOMANES TANAUCUM Hooker.

BRAZIL.

TRICHOMANES PEDICELLATUM Desv.

Tropical America (BRAZIL).

The three preceding species are *Lacosten*; the following three, called *Ptilophyllum*, seem to me to be as near to *Lacosten*.

TRICHOMANES ALATUM Swartz.

West Indies to Brazil. Stipes usually tufted, rarely subremote.

TRICHOMANES FIMBRIATUM Borchhaus.

TRINIDAD; GUIANA.

TRICHOMANES ARBUSCULA Deshaux.

West Indies to Brazil and Peru.

TRICHOMANES ANADROMUM Rosenthal.

COSTA RICA.

*Trichomanes bicornue* Hooker is a more divided relative of *T. ulatum*, from the Amazon; and *T. amazonicum* Christ is described as a local relative with less divided fertile fronds.

Fronds pinnate or pinnatifid, veins free: *Psilophyllum* van den Bosch.

TRICHOMANES POLYPODIOMES Linn.

Cuba and Mexico to Uruguay. Rhizome elongate.

TRICHOMANES CRINITUM Swartz.

Jamaica and Costa Rica to Ecuador.

TRICHOMANES CRISPUM Linnæus. Plate 8.

Cuba to Ecuador and Brazil. The type of the genus.

TRICHOMANES ACCEDENS Presl.

West Indies across Brazil.

TRICHOMANES SELLOWIANUM Presl.

Tropical America (BRAZIL).

TRICHOMANES CRISTATUM Kaulfuss.

Tropical America (BRAZIL).

TRICHOMANES GALEOTTII Fournier.

MEXICO; HONDURAS; CUBA.

TRICHOMANES PELLUCENS Kunze.

Tropical America (BRAZIL).

TRICHOMANES PILOSUM Raddi.

Guiana across Brazil.

TRICHOMANES LAXUM Kl.

Tropical America (BRAZIL).

TRICHOMANES LINDIGII Fournier.

COLOMBIA; BRAZIL.

TRICHOMANES LUDOVICIANUM Ros.

COSTA RICA.

Frond pinnate, veins cross-connected by false veinlets: *Neuromanes* Trev.

*TRICHOMANES PINNATUM* Hedwig.

Cuba and Mexico to Brazil.

*TRICHOMANES VITTARIA* B. C.

GUIANA; AMAZON.

Fertile frond simple. Frond pinnate, veinlets anastomosing: *Odontomanes* Presl.

*TRICHOMANES HOSTMANNIANUM* (Kl.) Kuhn.

GUIANA; AMAZON.

I have enumerated, with one exception, only the species in hand; and suppose that all American species which have been referred to *Ptilophyllum* as genus or subgenus are correctly placed there. The Oriental species so referred by van Alderwerelt do not belong here. Prantl was likewise wrong, in principle as well as in form, in referring to *Lacosteia* the Oriental *Cephalomanes*. The latter presents a most interesting example of evolution parallel in form to that of *Trichomanes*, the two originating independently in *Vandenboschia*.

#### 27. Genus FEEA Bory

*Feea* BORY, Dict. Class. d'Hist. Nat. 6 (1824) 446; PAUST, Hymen., (1843) 102; VAN DEN BOSCH, Synopsis, 6.

*Hymenostachys* BORY, Dict. Class. d'Hist. Nat. 6 (1824) 588; 8 (1825) 462; PREST., Hymen. (1843) 103.

*Homocotes* PREST., Abh. böhm. Ges. Wiss. V 5 (1848) 331 (not seen).

*Trichomanes* subgenus *Feea* et *Hymenostachys* HOOKER, Sp. Fil. 1 (1846) 114.

*Trichomanes* § *Feea*, HOOKER and BAKER, Syn. Fil. 71.

*Ptilophyllum* § *Homocotes* et *Feea*, PRANTL, Hymen., 48.

Genus *Trichomane* (ex affinitate *T. crispum*) derivatum, terrestre, rhizomate aut brevi-repente aut suberecto et radicibus validis sustenso, stipitibus subremotis vel caespitosis; frondibus dimorphis, sterilibus lanceolatis profunde pinnatisectis (deorsum rarius pinnatis) segmentis integris, fertilibus linearibus; aliter *Trichomane* conforme.

Tropical America, from the Amazon basin to the Caribbean, one species extending into Central America and one into the West Indies.

#### SPECIES OF FEEA

*FEEA HETEROPHYLLA* (H. B. W.) Copeland comb. nov.

*Trichomanes heterophyllum* H. B. W. in Willdenow, Sp. Pl. 3 (1810) 503.

*Homocotes heterophylla* PREST.

*Feca Humboldtii* VAN DEN BOSCH, Ned. Kr. Arch. 4 (1859) 347.

*Feca spruceana* VAN DEN BOSCH, *ibid.*

#### Amazon basin, Guiana.

*FECA DIVERSIFRONS* (Bory) Copeland comb. nov.

*Hymenostachys diversifrons* Bory, Dict. Class. d'Hist. Nat. 8 (1825) 462.

*Feca Boryi* VAN DEN BOSCH.

#### Guiana to southern Mexico and Bolivia.

*FECA TROLLII* (Bergdahl) Copeland comb. nov.

*Trichomanes Trollii* BERGPOLT, Flora 127 (1933) 264, text figs.

#### BOLIVIA; GUIANA?

*FECA BOTRYOIDES* (Kaulfuss) van den Bosch.

*Trichomanes botryoides* KAULFUSS.

*Feca nana* BORY, the type of the genus.

#### GUIANA; PANAMA; PERU.

*FECA OSMUNDIODES* (DC.) Copeland comb. nov. Plate 9.

*Trichomanes osmundoides* DC., in Poiret (Lam.) Enc. 3 (1808) 65.

*Feca polypodiina* BORY, Dict. Class. d'Hist. Nat. 6 (1824) 446.

*Feca spicata* PRIST., Abh. böhm. Ges. V 5 (1848) 330.

#### Guiana to West Indies and Ecuador.

There remains *Trichomanes platynechis* Domin, of Jamaica, which I have not seen. As it has been found but once, in a thoroughly collected locality, it seems likely to be an aberrant individual specimen of *F. osmundoides*.

These five species seem, with a sufficient measure of probability, all to be derived from the immediate group of *Trichomanes crispum*; as that species is construed in Species Filicum, they may all be derived from it. On the assumption that they represent a natural derived group, I treat them as one genus; but it must be conceded that this assumption is not as well grounded as is that of their common descent from a single group. That is, they may represent two, or even three, independent derived lines, from a common source.

*Feca heterophylla*, Presl's genus *Homocoles*, has a somewhat elongate rhizome with scirite, not clustered, stipes. The fertile frond is pinnatifid, with numerous, closely placed, short, truncate segments, each (except near the apex of the frond) bearing several sori, which collectively form a border on the frond. Goebel<sup>48</sup> has clearly established its affinity to "*T. cris-*

<sup>48</sup> Flora 124 (1930) 381-388.

pauc.<sup>20</sup> I have several of the *Laetzelburg* specimens, and so know exactly what his *T. heterophyllum* is, but cannot so definitely locate his *T. crispum*. It was like *T. heterophyllum* in pubescence. As to the length of the rhizome, Goebel is silent. Broadly construed, *T. crispum* includes forms variable in pubescence and in the character of the rhizome—18 species of various authors, according to Synopsis Filicum, 25 by this time.<sup>21</sup>

*Feca diversifrons* (Bory's genus *Hymenostachys*) and *F. Trollii* have entire fertile fronds, the marginal sori sunk in the lamina. The pubescence is comparatively scant and uniform, distinct from that of *F. heterophylla*, but within the range of *T. crispum* s. lat. The rhizome is short and the fronds tufted, as in the typical *T. crispum*. This pair of species is treated in most detail by Bergdolt.<sup>22</sup>

*Feca botryoides* and *F. osmundoides* (Bory's genus *Feca*) have the lamina elided between the sori which stand side by side on an almost wingless rachis. The fronds are tufted on a suberect rhizome.

The fact that the plants I combine in a genus *Feca* show affinity to at least two groups of plants, whether or not the latter are well regarded as belonging in a single species, is not proof that my *Feca* is diphyletic or polyphyletic (except in the sense in which every human family becomes more so by admixis with each generation). Because dimorphism is a rare phenomenon in Hymenophyllaceae, it seems probable that as a genetic change (or mutation), the nearly related plants which exhibit it result from one such occurrence. The difference in rhizome and in pubescence may be the result of parallel evolution—which Bergson might have expected to happen. More probably, in my own present view, they are due to hybridization.

Some species of *Feca* have conspicuous peculiarities not found in *T. crispum* or its immediate group. Thus *F. diversifolia* has the lamina of the fertile frond several cells thick. I treat this as an important generic characteristic of *Davalliopsis*, and as one such character of *Cardiomanes* and *Hymenoglossum*, but as of minor significance or utility in the cases of *Mecodium dilatatum* and its relatives. In the case of *F. diversifolia*, it looks like an almost inevitable mechanical consequence of the congestion of the sori. Other *Feca* species show a tendency to be more

<sup>20</sup> Maxon, Pterid. of Porto Rico (1926) 501.

<sup>21</sup> Flora 127 (1933) 251.

than one cell thick.<sup>51</sup> Striæ (false veinlets) occur in some species. *F. diversifolia* has veins excurrent from the costa, as in the group of *T. pinnatum*.

*F. diversifrons* and *F. Trollii* have anastomosing veins, a feature as unique in this family as is the dimorphism.

We have then a choice of three courses:

1. To leave these ferns in *Trichomanes*. Its ancestry is there, and there is some dimorphism at two other places in this parent genus.

2. To recognize two or three genera, here combined as *Feca*.

3. To treat the group of five species as one genus. I have chosen this course because it seems to give expression most conveniently to the noteworthy common characteristics of this group of related species.

It may be noted here, though the subject is a *Trichomanes*, that Christ referred to "Sect. *Feca*" his *T. amazonicum*<sup>52</sup> described as distinguished from *T. bicorne* Hooker, found at the same place, by having the fertile fronds bipinnatifid, while the sterile fronds, like all fronds of *T. bicorne*, are tripinnatifid. Christ injected this foreign element into *Feca*, and then condemned the latter for not being a natural group.

The remaining dimorphous *Trichomanes* is *T. Villaria*, derived from *T. pinnatum*. It is the type of Presl's genus *Neurophyllum*, this name being untenable for it. It was characterized essentially by the venation, and included *T. pinnatum*. Trevisan and van den Bosch called this group *Neuromanès*, but its proper name, if it is treated as a genus, is probably *Odontomanès*.

## 28. Genus DIDYMOGLOSSUM Desvaux

*Didymoglossum* DESVAUX, Prod. (1827) 310.

*Didymoglossum* PRESL, Hymen. (1843) 114; VAN DEN BOSCH, Synopsis 39, partim.

*Hemiphtebium* PRESL, Hymen. (1843) 117; PRANTL, Hymen. 45; non *Didymoglossum* VAN DEN BOSCH, Hymen. Javan. 55; nec. Prantl et sect. *Trichomanes*, Hymen. 52.

Sori marginales exserti; sporangia sessilia receptaculo communi cylindraceo inserta; involucrium ureolatum ore hiantie biligulatum. Habitus *Trichomanidis*.—DESVAUX, loc. cit.

Type epiphytica, radicibus (an semper?) carentibus, rhizomate filiforme, intricato, velutino; frondibus remotis, aut parvis

<sup>51</sup> Mettenius, Abh. d. Math.-phys. Classe d. k. Sächs. Ges. Wiss. 7 (1864) 461.

<sup>52</sup> Hedwigia 44 (1835) 359.



aut minimus, pinnatifidus vel saepius integris, margine setiferis, venulis aut pinnatim aut flabellatim insertis, venulis spuris interspersis; soris marginalibus, involucre elongato, ore typico bilabiato, receptaculo extruso.

Range: Tropical and subtropical America, across Africa to Ceylon, on trees and rocks in wet places.

The false veinlets and bilabiate involucre suggest affinity to *Crepidomanes*, which, however, is probably very remote; the marginal hairs, to *Sphacrocionium*. I suspect more real affinity to *Trichomanes* (*Lacostea*).

#### SPECIES OF DIDYMOGLOSSUM

**DIDYMOGLOSSUM ROBINSONII** (Baker) Copeland comb. nov.

*Trichomanes Robinsonii* BAKER, Journ. Linn. Soc. 9 (1867) 333, pl. 8 B.

*Trichomanes montanum* Hooker non Salisb. and *T. quercifolium* Hook. and Grev., non Desv. are synonymous or nearly so.

NATAL; MADAGASCAR; Tropical America.

**DIDYMOGLOSSUM KRAUSSII** (Hook. and Grev.) Presl.

Cuba to Brazil.

**DIDYMOGLOSSUM REPTANS** (Sw.) Presl.

WEST INDIES; VENEZUELA; COLOMBIA.

**DIDYMOGLOSSUM HYMENOIDES** (Hedwig) Copeland comb. nov.

*Trichomanes hymenoides* HEDWIG, Fil. Gen. et Sp. (1799) pl. 4, fig. 3.

*Trichomanes muscoides* SWARTZ (1801).

*Didymoglossum muscoides* DESVAUX, the type of the genus.

Jamaica to Brazil.

**DIDYMOGLOSSUM PUNCTATUM** (Polak) Desvaux.

Cuba to Brazil.

**DIDYMOGLOSSUM SPHENOIDES** (Kunze) Presl.

Florida to Brazil.

**DIDYMOGLOSSUM PUSILLUM** (Sw.) Desvaux.

Cuba to Venezuela; the type of *Hemiphlebium*.

**DIDYMOGLOSSUM SOCIALE** Fée.

BRAZIL.

**DIDYMOGLOSSUM CORDIFOLIUM** Fée.

WEST INDIES; GUYANA.

**DIDYMOGLOSSUM FONTANUM** (Lindb.) Copeland comb. nov.

*Trichomanes fontanum* LINDB., Arkiv. Bot. 1 (1903) 44.

BRAZIL.

**DIDYMOGLOSSUM PARSTIANUM** (K. Müller) van den Bosch.

**BRAZIL.**

**DIDYMOGLOSSUM LINEOLATUM** van den Bosch.

Florida to Colombia. Without unconnected veinlets. *Trichomanes Curtii* Rosenstock, of Costa Rica, is hardly distinct.

**DIDYMOGLOSSUM PETERSII** (Gray) Copeland comb. nov.

*Trichomanes Petersii* GRAY, Am. Journ. Sci. II 15 (1853) 326.

Georgia to Mississippi. The involucre is not bilabiate.

**DIDYMOGLOSSUM LIBERIENSE** Copeland.

*Trichomanes liberianae* COPELAND, Trich. (1933) 160, pl. 9, figs. 516.

**LIBERIA.**

**DIDYMOGLOSSUM EXIGUUM** (Beddome) Copeland comb. nov.

*Hymenophyllum exiguum* BEDDOME, Ferns Brit. India (1868), pl. 275.

*Trichomanes exiguum* BAKER, COPELAND, Trich. (1933) 205, pl. 32, figs. 1, 2.

**CEYLON.**

**DIDYMOGLOSSUM WALLII** (Thwaites) Copeland comb. nov.

*Trichomanes Wallii* THWAITES, Trimen, Journ. Bot. 23 (1885) 274;

COPELAND, Trich. (1933) 206, pl. 32, figs. 3-5.

**CEYLON.**

*Trichomanes Giesenhagenii* C. Chr., Comores, evidently belongs here.

*Trichomanes Barklium* Baker, Mauritius, may belong here, but is without false veins, and the involucre is not bilabiate.

In spite of a general indisposition to creating new binomials for species not known to me personally, I do so for the following three, because the identity of the species seems to be well established by the comparative and comprehensive study of Lindman.<sup>53</sup>

**DIDYMOGLOSSUM MELANOPUS** (Baker) Copeland comb. nov.

*Trichomanes melanopus* BAKER, Syn. Fil. (1874) 465; LINDMAN, loc. cit. 28, figs. 11-14.

**ECUADOR.**

**DIDYMOGLOSSUM MOSENI** (Lindm.) Copeland comb. nov.

*Trichomanes Mosenii* LINDMAN, loc. cit., 46, figs. 25 D, E; fig. 27.

**BRAZIL.**

<sup>53</sup> Ark. för Bot. (1903) 7-55.

*DIDYMOGLOSSUM MYRIONEURON* (Lindm.) Copeland comb. nov.

*Trichomanes myrioneuron* LINDMAN, loc. cit., 48, figs. 25, B-I, 28, 29.

GUIANA; BRAZIL; COSTA RICA?

VENEZUELA.

*T. goebelianum* Gies., another "smallest of all ferns," the frond 2.5 to 3 mm long, is a *Didymoglossum* with aberrant involucre, obconic, half-immersed, with broad, unbordered lips.

## 29. Genus *LECANIUM* Presl<sup>4</sup>

*Lecanium* PRESL, Hymen. (1843) 103, pl. 1.

Costa nulla. Venae flabellatae, creberrimae, subparallelae, pluries furcatae, crassiores apice soriferae. Venulae tenuissimae in superiori parte frondis libere exorientes et squamas duas oppositas supramarginales patellariformes patentis gerentes. Sorus intramarginalis, immersus. Indusium lineari-cylindricum, elongatum, limbo hypocraterinomorfo patente erenulato. Capsulae receptaculo filiformi indusium longe excedenti undique affixae, sessiles, angulato-lenticulares, valde excentricae (pene marginem) affixae.

Species, *Lecanium membranaceum* (*Trichomanes membranaceum* L.).

—PRESL, loc. cit.

The genus was maintained by van den Bosch in his *Bijdrage*, and placed in his suborder *Diplophyllaceae*. Prantl<sup>55</sup> treated it as a subgenus of his *Hemiphlebiium*. All other authors have left it in *Trichomanes*.

<sup>4</sup> The validity of this name is challenged on two grounds: That *Achomanes* Necker is an older name, validly published, and appropriate; and that *Lecanium* Presl (1843) is invalidated by *Lecanium* Reinwardt (1825). As to the first: *Achomanes* Necker does seem to have been published properly under the Revised Statutes of 1930, for the first time since we had rules backed by the authority of a Congress. No species was ever named in the genus. It would have included several of the genera of later writers, and Presl, *Hymenophyllaceae* 107, made a competent election among these; he restricted it (with the status of a section) to that one group, explicitly included by Necker, which is typical *Trichomanes*, typified by *T. crispum*. The same rules which for the current decade validate Necker's publication of the genus thus make it an absolute synonym of *Trichomanes*.

As to *Lecanium* Reinwardt: Reinwardt in 1824 named a genus *Oncidium*, typified by *O. carnosum*. His attention being called to the prior use of this name by Kauffuss (1820), he immediately (*Flora* (1825) 3. Beilage, 48) suggested *Lecanium* as a substitute, and went on to suggest that *Lecanopteris* would be preferable, not being subject to confusion with *Lecanora*. The publication of both names, as synonyms, being thus avowedly tentative, both fall under Rule 40 of the Statutes of 1930. Biume (1828) validated *Lecanopteris*, as correctly shown by the citation in Christensen's Index; and *Lecanium* Reinwardt did not and does not legally exist.

<sup>4</sup> Page 76.

Fronds of more than one layer of parenchyma were first ascribed to this plant by Müller,<sup>56</sup> and this was agreed to by van den Bosch. As shown by Müller, by Mettenius,<sup>57</sup> and by Giesenhagen,<sup>58</sup> plural cell layers are not everywhere present. The adult plant<sup>59</sup> (Plate 10) is without roots, using metamorphosed shoots as substitutes.

Somewhat isolated in the foregoing respects, the genus is unique in its marginal scales, correctly described by Presl and figured by Müller, wrongly (as pelate) by Hooker,<sup>60</sup> inaccurately by Giesenhagen as spiral or snail-shaped, and most completely by Mettenius<sup>61</sup> and by Maxon,<sup>62</sup> "A pair of concave, cordate-orbicular, sessile, apposed, membranous squamules, these closely bordering the younger and smaller blades, deciduous in the larger ones." They are borne on the joint apices of two or more false veinlets, between each pair of true veinlets. They apparently serve (Giesenhagen) to hold water in the space they inclose, or eventually to maintain a measure of humidity about the thin and tender margin of the young fronds.

Range: The West Indies, and from Nicaragua to Bolivia and Venezuela.

### 30. Genus SELENODESMIUM Copeland gen. nov.

*Trichomanes* § *Sclerodesmum* PRANTL, Hymen. (1873) 53.

Folia polysticha, lamina triangularis, petioli fasciculus sect. transv. semilunaris diarchus; paleae peltatae.—PRANTL, loc. cit.

Rhizomate valido, ad terram brevi-repente vel suberecto, stipitibus approximatis vel caespitosis, elongatis setis brevibus obscuris deciduis vestitis; frondibus basi acutis plus minus rigidis, pinnulis semidissectis parte mediale plerumque integra cum venis parallelis, venis deinde in segmenta monophlebia divergentibus; parietibus cellularum crassis conspicue vittatis, rarius undulatis; involucri cylindraccis ore haud bilabiato, receptaculo valde exserto.

A well-defined pantropic group of ill-defined species. The name probably refers to the "semilunar" cross section of the

<sup>56</sup> Bot. Zeit. 3 (1845) 577, pl. 4.

<sup>57</sup> Page 460, pl. 1, figs. 10, 11.

<sup>58</sup> Page 444, figs. 4, 8.

<sup>59</sup> Giesenhagen, 444, 445.

<sup>60</sup> Exotic Flora, pl. 76.

<sup>61</sup> Hymen. 469.

<sup>62</sup> Pterid. of Porto Rico, 498.

bundle of the stipe. *Trichomanes rigidum* Sw. is the type species, but the genus reaches its "more typical" development in the Malay-Polynesian region, where the remarkably thick and pitted walls and deltoid fronds are its best diagnostic characters. In America the fronds are less harsh and the walls more or less zigzag, as is true of young (and rare aberrant) Oriental specimens. The plants are strictly terrestrial and intolerant of desiccation. Stout proproots commonly support the stems of old plants above the surface of the ground. In spite of past confusion of the species, I see no evident affinity between this group and *Nesopteris*.

## SPECIES OF SELENODESMIUM

**SELENODESMIUM RIGIDUM** (Sw.) Copeland comb. nov.

*Trichomanes rigidum* SWARTZ, Prod. (1788) 137.

Tropical America (JAMAICA).

**SELENODESMIUM MANDIOCCANUM** (Raddi) Copeland comb. nov.

*Trichomanes mandiocannum* RADDI, pl. Brasil, 1 (1825) 61.

BRAZIL; ? AFRICA.

**SELENODESMIUM BATRACHOGLOSSUM** Copeland.

*Trichomanes batrachoglossum* COPELAND, Trich. (1933) 244, pls. 50, 51, figs. 1, 2.

LIBERIA.

**SELENODESMIUM CUPRESSOIDES** (Desv.) Copeland comb. nov.

*Trichomanes cupressoides* DESVAUX, Prod. (1827) 330; COPELAND, Trich. (1933) 242, pl. 49.

East African Islands; ? AFRICA.

**SELENODESMIUM STYLOSUM** (Poir.) Copeland comb. nov.

*Trichomanes stylosum* POIRET, Lam. Enc. 8 (1808) 82; COPELAND, Trich. (1933) 243, pl. 51, figs. 3-5.

East African Islands.

**SELENODESMIUM OBSCURUM** (Blume) Copeland comb. nov.

*Trichomanes obscurum* BLUME, Enum. (1828) 227; VAN DEN BOSCH, Hymen. Javan. 23, pl. 17; COPELAND, Trich. (1933) 233, pls. 43, 44.

Java to India, Formosa, and Papua.

**SELENODESMIUM EXTRAVAGANS** Copeland.

*Trichomanes extravagans* COPELAND, Trich. (1933) 240, pl. 48.

LUZON.

## SELENODESMIUM DENTATUM (v. d. B.) Copeland comb. nov.

*Trichomanes dentatum* VAN DEN BOSCH, Ned. Kruid. Arch. 51 (1861) 182; Journ. Bot. Neerl. 1 (1861) 363; COPELAND, Trich. (1933) 237, pls. 45, 46.

## POLYNESIA.

## SELENODESMIUM ELONGATUM (A. Cunn.) Copeland comb. nov.

*Trichomanes elongatum* A. CUNN., Comp. to Bot. Mag. 2 (1836) 368; HOOKER, Ic. Pl. pl. 704; COPELAND, Trich. (1933) 239, pl. 47, figs. 1, 2.

## NEW ZEALAND; eastern Australia.

## SELENODESMIUM LONGICOLLUM (v. d. B.) Copeland comb. nov.

*Trichomanes longicollum* VAN DEN BOSCH, Ann. Sc. Nat. IV 15 (1861) 90; COPELAND, Trich. (1933) 240, pl. 47, figs. 3-5.

## NEW CALEDONIA.

## 31. Genus DAVALLIOPSIS van den Bosch

*Davalliopsis* VAN DEN BOSCH, Eerste Bijdrage (1861) 323.

Terrestris, rhizomate crasso adscendente, stipitibus caespitosis, elongatis, validis, sulcatis, fasciulis triangularibus; fronde egregie magna, tri-quadrupinnatifida, basi acuta, lamina stratis tribus cellularum composita; involucrio infundibuliforme ore expanso, receptaculo exserto.

Probably a single species, of tropical America.

## DAVALLIOPSIS ELEGANS (Rich.) Copeland comb. nov. Plate 11.

*Trichomanes elegans* RICH., Act. Soc. Hist. Nat. Paris 1 (1792) 114.

Van den Bosch established this genus imperfectly, publishing no specific name under it; but his name fortunately was retained for subgeneric or section use by Prantl and Christensen.

The three-layered lamina<sup>53</sup> is the best diagnostic character of *Davalliopsis*. Such affinity as I see ground for suspecting is to *Selenodesmium*; but the wall structure of the latter is distinct, and the resemblance may be superficial.

Christensen says of *T. pachyphlebium* C. Chr. "Its nearest relative seems to be the American *T. elegans* Rich."<sup>54</sup> If it be indeed a *Davalliopsis*, it presents a case parallel to that of *Didymoglossum*, of possible Antarctic origin and escape by way of the Cape.

## 32. Genus MACROGLENA Copeland gen. nov.

*Trichomanes*, § *Macroglena* PRESL, Abh. böhm. Ges. Wiss. V 5 (1848) 333.

<sup>53</sup> Mettenius, pl. 4, figs. 1-4.

<sup>54</sup> Bonaparte, Notes Pterid. 12 (1920) 16, fig. 5; Pterid. Madag. 6.

Terrestres et epiphyticae, rhizomate valido, elongato vel breve, stipitibus remotis, confertis vel caespitosis; fronde majuscula pinnatim decomposita, axibus angustissime alatis segmentis deinde anguste linearibus vel setiformibus, rigidis; soris pantoctis, receptaculo cupuliforme vel rarius elongato, plerumque truncato nunquam bilabiato, receptaculo exserto.

Typus, *M. meifolia* (Bory sub *Trichomanes*).

Range: Old World Tropics, south to New Zealand and Madagascar.

The extremely narrow (or eventually wanting) lamina, which is the conspicuous characteristic of this genus, is obviously not a primitive character, but may with confidence be regarded as the result of reduction. As has repeatedly to be noted, reduction is likely to result in similarity of plants of diverse ancestry. There are American species of *Vandenboschia* (*Leptomanes*) which are reduced in the same manner; these are distinguished from *Macroglena* by texture, and are not subject to confusion with it. But it may be that in the Orient or South, also, this kind of reduction has occurred in more than one line, and that thus I have been led to include here some species not nearly enough related to belong in one genus.

As I construe the genus, it includes *T. strictum* of New Zealand, and is old enough to be of direct Antarctic origin. I would rather believe that the Madagascar species are of Antarctic origin independent of *T. strictum*; and *T. angustatum* of Tristan d'Acunha, which I do not know, may survive as a third independent escape from Antarctica. Some species seem to be related to *Selenodesmium*, this being indicated by cell structure rather than by form of frond. I regard the two genera as cognate, rather than as derived one from the other.

*Macroglena* as a genus is unspecialized either as to the length of the rhizome or the structure of the cell walls—items usually characteristic of genera in this family. The type species has undifferentiated walls, but its stipes range from remote to congested.

#### SPECIES OF MACROGLENA

*MACROGLENA MEIFOLIA* (Bory) Copeland comb. nov.

*Trichomanes meifolium* Bory, Willdenow, Sp. Pl. 5 (1810) 509; KAULPUS, Enum. 265, pl. 2; CHRISTENSEN, Pterid. Madagascar (1932) 7, pl. 1, figs. 18-20; COPELAND, Trich. (1933) 265.

Christensen regards this species as confined to Madagascar and Réunion. As I construe it, more broadly, including *T. Plumia* Hooker, it ranges also from Malaya to Samoa.

**MACROGLENA PARVIFLORA** (Poir.) Copeland comb. nov.

*Trichomanes parviflorum* Poir., LAMARCK, Enc. 8 (1808) 83; CHRISTENSEN, Pterid. Madag. (1932) 7, pl. 1, figs. 10-13.

MASCARENES; farther range, to Polynesia, in doubt.

**MACROGLENA ANGUSTIMARGINATA** (Bonaparte) Copeland comb. nov.

*Trichomanes angustimarginatum* BONAPARTE, Notes Pterid. 16 (1925) 12; CHRISTENSEN, Pterid. Madag. (1932) 7, pl. 1, figs. 14-17.

MADAGASCAR.

**MACROGLENA GEMMATA** (J. Sm.) Copeland comb. nov.

*Trichomanes gemmatum* J. Sm., Hooker's Journ. Bot. 3 (1841) 417; BAKER, Syn. Fil. (1867) 87; COPELAND, Trich. (1933) 260, pl. 61, fig. 2.

MALAY PENINSULA; BORNEO.

**MACROGLENA SETACEA** (v. d. B.) Copeland comb. nov.

*Trichomanes setaceum* VAN DEN BOSCH, Ned. Kr. Arch. 5<sup>1</sup> (1861) 176; COPELAND, Trich. (1933) 260, pl. 57, fig. 1.

MALAY PENINSULA; BORNEO; PHILIPPINES.

**MACROGLENA COMPACTA** (v. A. v. R.) Copeland comb. nov.

*Trichomanes compactum* v. A. v. ROSENBURGH, Nova Guinea 14 (1924) 57; COPELAND, Trich. (1933) 263, pl. 49.

NEW GUINEA.

**MACROGLENA ASAE-GRAYI** (v. d. B.) Copeland comb. nov.

*Trichomanes Asae-Grayi* VAN DEN BOSCH, Ned. Kr. Arch. 5<sup>2</sup> (1861) 180; COPELAND, Trich. (1933) 264, pl. 61, fig. 1.

FIJI; SAMOA; TAHITI.

**MACROGLENA FLAVO-FUSCA** (v. d. B.) Copeland comb. nov.

*Trichomanes flavo-fusum* VAN DEN BOSCH, Ann. Sc. Nat. IV 15 (1861) 88; COPELAND, Trich. (1933) 264, pl. 58, fig. 2.

NEW CALEDONIA.

**MACROGLENA SCHLECHTERI** (Brause) Copeland comb. nov.

*Trichomanes Schlechteri* BRAUSE, Bot. Jahrb. 49 (1912) 10; COPELAND, Trich. (1933) 268, pl. 60.

NEW GUINEA.

**MACROGLENA LAETA** (v. d. B.) Copeland comb. nov.

*Trichomanes laetum* VAN DEN BOSCH, Ann. Sc. Nat. IV 15 (1861) 90; COPELAND, Trich. (1933) 261, pl. 57, fig. 2.

NEW CALEDONIA.

**MACROGLENA CAUDATA** (Brack.) Copeland comb. nov.

*Trichomanes caudatum* BRACKENRIDGE, U. S. Expl. Exped. 16 (1854) 256, pl. 30, fig. 5; COPELAND, Trich. (1933) 262, pl. 57, figs. 3-5; pl. 58, fig. 1.

Tahiti to Queensland.



*MACROGLENA STRICTA* (Menzies) Copeland comb. nov.

*Trichomanes strictum* MENZIES, Hooker and Greville, Ic. Fil. (1831)  
pl. 122; COPELAND, Trich. (1933) 259, pl. 56, figs. 3, 4.

NEW ZEALAND.

### 33. Genus ABRODICTYUM Presl

*Abrodictyum* PRESL, Hymen. (1843) 112, pl. 7.

Epiphyticum ad truncos filicum, rhizomate breve, parvo, stipilibus dense caespitosis, basi setosis, teretibus; fronde mediocre bipinnatifida vel subtripinnatifida anguste elliptica, pendente, segmentis linearibus; cellulis (marginalibus exceptis) transversim elongatis, et oblique longitudinaliter instructis, parietibus conspicue vittatis; involucri infundibuliforme limbo patente receptaculo setaceo valde elongato.

A single species, without particular evident affinity, common on tree-fern trunks in the Philippines, and reported from Celebes (Kjellberg and Christensen) and the Moluccas (van den Bosch).

Van den Bosch altered the name to *Habrodictyon*.

#### SPECIES OF ABRODICTYUM

*ABRODICTYUM CUMINGII* Presl.

A large majority of the species of the Hymenophyllaceae are found in the moist Tropics. In this sense only, the statement of Sadebeck, is correct: "Das Centrum der geographischen Verbreitung ist in den Tropen."<sup>5</sup> The origin of the family, as it now exists, was Austral. Sadebeck notes that New Zealand is "fast ein zweites Centrum"; and both he and Christ, as others before them, note the wealth of these plants in Antarctic America. But these conditions seem to have been interpreted as evidence that ferns of tropic origin find there a sufficiently uniform humidity and temperature. Like the Gleicheniaceae and *Blechnum*, as to both of which Diels notes how far south they "vordringen," the Hymenophyllaceae present most perfect geographic evidence of Antarctic origin, and of migration into, not from, the Tropics.

The Hymenophyllaceae constitute about one fourteenth of the world's fern species, and this proportion may rise to about one in twelve in the Tropics. This is the closest whole number for Borneo and Java. Eastward migration from the Malay

<sup>5</sup> Nat. Pflanzenfamilien. Teil I Abt. 4 (1902) 104.

region is always assumed to be responsible for the bulk of the fern population of Polynesia. In Fiji and the Society Islands the proportion of Hymenophyllaceæ rises slightly, to one in ten. Diversion of this migration to the northeast extended it to Hawaii; to the southeast (if it occurred), to New Zealand. This is the process pictured by "vordringen," and if the picture were correct, the composition of the fern floras of Hawaii and New Zealand should correspond reasonably to that of Malaya, for the climatic conditions of both permit the filmy ferns to thrive. Actually, they are one in eighteen of all Hawaiian<sup>60</sup> ferns and one in five in New Zealand. Going south in New Zealand, the proportion continues to rise, reaching one in three in the Stewart Islands.<sup>61</sup> Ten species of *Hymenophyllum* are reported (Cockayne, Holloway) even from the Auckland Islands, beyond 50° south latitude. In the Northern Hemisphere the climate of the wet side of southern New Zealand is duplicated, at the same latitude, from Portland to Sitka, but Hymenophyllaceæ are totally absent.

In far southern America, in the narrow strip west of the Andes, the climatic conditions of New Zealand are sufficiently duplicated, and there is a similar wealth of species of filmy ferns, although few species are common to New Zealand.<sup>62</sup> As this area, being continental, can be given only an arbitrary northern limit, I have not tried to determine the proportion of Hymenophyllaceæ to all ferns; but it will correspond roughly to southern New Zealand. Juan Fernandez is an outlying fragment of this region, and its Hymenophyllaceæ (Christensen and Skottsberg, 1920), are fifteen out of forty-nine ferns, not quite one in three. In the Falkland Islands they seem to be three out of five.

<sup>60</sup> The Hawaiian climate, as a whole, is less appropriate to these ferns than that of New Zealand, but there are sufficient areas that are perfectly suitable. Hawaiian Polypodiaceæ, as a whole, are obviously of Malayan origin. Of the eight Hymenophyllaceæ, only *Gonocormus minutus* and *Callistopteris Baldwinii* suggest possible Malayan origin; the others are endemic; *Vandenboschia durallioidea* and *V. cyrtotricea*, apparently American in affinity; *V. draytoniana* and *Merodium recurvum*, far southern; and two species of *Sphaerocarponium*, Antarctic (New Zealand) rather than anything else.

<sup>61</sup> Holloway, Trans. N. Z. Inst. 55 (1924) 84.

<sup>62</sup> The exact number is a question of specific identity. *Hymenophyllum tanbridgeense*, *H. pettatum*, and *Sphaerocarponium acroginosum* are represented by forms which have been regarded as specifically identical.

South Africa seems never to have been as near to Antarctica as New Zealand and America have been, and its present climate would not permit a rich hymenophyllaceous flora, if it ever had one. *Mecodium rarum*, *H. tunbridgensis*, and *H. peltatum* are represented by identical, or very similar plants in New Zealand and South Africa. *Sphaerocionium Lyallii* and *S. Marlothii* are nearly related. *Didymoglossum Robinsonii*, first described under this specific name from Natal, is the most southern representative of its genus. If, by analogy with other genera, we impute direct Antarctic origin to *Didymoglossum*, it is the only genus (except, possibly, *Darallbopsis*) that seems to have escaped from Antarctica by this route only; and this will explain its unique present range—America, Africa, and eastward only as far as Ceylon. Nothing in the family in South Africa seems, with much probability, to have had a northern origin. Because of the paucity of species, this rather negative statement is all that is possible. The comparative absence of immigrants from Antarctica must be responsible for the paucity of the family in all Africa and its islands.<sup>69</sup> According to Kuhn's old figures the proportion to all ferns is one in eighteen. Even this low proportion is reached by including St. Helena and Tristan d'Acunha which may well have received their filmy ferns directly from Antarctica.

The inability of tropical Hymenophyllaceæ to migrate from the Tropics is attested by their paucity in the North—five species in the United States (three of which reach only to southern Florida), and three in Europe. The Japan region has more, but not nearly as many as have been described. This must be a recent element in the Japanese flora, or it should have reached America when the North Pacific climate was more favorable.

The diversity of far southern Hymenophyllaceæ presents evidence of Antarctic origin as conclusive as that of wealth of species. In the first place, every genus common to America and Malaya, unless it be *Microgonium*, occurs in New Zealand, and all others except *Selenodesmium* in South Chile. As to *Microgonium*, it is doubtful whether its one American species, *M. Hookeri*, really belongs in the genus. With the genera *Hymenophyllum*, *Meringium*, *Mecodium*, *Sphaerocionium*, *Vandenboschia*, and *Selenodesmium*, New Zealand has also *Crepidopteris*

<sup>69</sup> Fil. Africa (1868).

of wide range. I cannot now authenticate the statement in my treatise on Trichomanes,<sup>70</sup> that *T. bipunctatum*, a *Crepidomanes*, is in New Zealand; it is common in southern Polynesia, and thence in Madagascar. Besides these large genera, New Zealand has *Cardiomanes*, altogether isolated, *Polyphlebium*, related to *Vandenboschia*, and *Apteropteris*, probably derived from *Sphaerocionium*. *Diploophyllum* (with another name) may be added to this list if one choose to recognize it as a genus.

Antarctic America is still richer in peculiar species and genera. With its outlying islands it has *Scerpyllopsis*, which has been referred to both *Trichomanes* and *Hymenophyllum*. *Hymenoglossum* is as isolated as *Cardiomanes*. *Leptocionium* shares the characteristics of *Meringium* and *Sphaerocionium*.

There survive then at least six genera restricted to the far South. Of the genera which either never were there or do not survive there, only *Didymoglossum* and *Microgonium* are on both sides of the Atlantic. *Didymoglossum* has a representative in Natal, which suggests Antarctic origin; it does not reach Malaya and Polynesia. *Microgonium* is doubtfully in America.

The genera which do not occur in the far South can be derived from those which survive there, in each hemisphere, locally, from the local representatives of the originally Antarctic genera, with the single possible exception of *Abrodictyum*, which may be derived from *Sclenodesmium*, but is more isolated than any other tropical genus. With this single possible exception, then, the entire family consists of genera surviving in the far South, or of the descendants of these genera. The geographic evidence is conclusive.

Evidence that Antarctica could have been the source of the family still remains to be presented, since the Antarctic continent is not now a place where any fern survives. There is not much palaeontological evidence on the subject, but two quotations may suffice as to the general fact. In the *Glaciology of Wright and Priestly*, a volume of the report of the British Antarctic Expedition, it is stated in italics: "Glacial conditions have been the exception and not the rule in Antarctica."<sup>71</sup> And "In the upper Oligocene or lower Miocene, once more a temperate to subtropical flora holds sway over some portion of the Antarctic Continent."<sup>72</sup> No approximately complete land con-

<sup>70</sup> Page 177.

<sup>71</sup> (1922) 44.

<sup>72</sup> Op. cit., 446.

nection is necessary for the dispersal of these plants. In the absence of fossils, the evidence of suitable climate is all that can be expected. If the Hymenophyllaceæ of today are the descendants of Oligocene migrants from Antarctica, the elapsed time must have sufficed, by its length, for their present dispersal and diversification; and, by its shortness, to account for their limited northern dispersal, and for the absence elsewhere of such very divergent or generalized (*Serpyllopsis*) genera as are found in the far South.

The pantropic genera are *Mecodium*, *Sphaerocionium*, *Hymenophyllum*, *Meringium*, *Vandenboschia*, and *Selenodendrium*, with which *Didymoglossum* may be included, although wanting in the far eastern region. These are all found now in the far South, where their surviving species are traces of the path of their migration to the Tropics. They were evidently differentiated as genera in Antarctica, and this cannot have occurred later than early Miocene. It may have been earlier, but not indefinitely earlier.

During the warm era which ended in the Miocene, these genera presumably became differentiated and were able to emigrate. The change at the end of that era did not drive them out, except as possibly subantarctic land became habitable under the influence of the Antarctic refrigeration. Directly, the Antarctic cold merely exterminated whatever was there, very likely including older, more primitive forms which, if they had survived would let us construct the trunk of the hymenophyllaceous genealogical tree, of which we now have only these main branches, some comparatively abortive branches represented by the small genera of the far South, and the more recent branches (of the main branches), represented by the tropical genera of limited distribution.

The still earlier history of the family is more a matter of speculation, unsupported, I suspect, by any fossil evidence whatever. Its locus may have been Antarctica from the time the phylum became identifiable. That there is no living representative which is unlikely to have had an Antarctic ancestor, creates a presumption against an original differentiation of the family in some other region.

Of course, the family had ancestors. These are homosporous leptosporangiate ferns, of the same general evolutionary status as Gleicheniaceæ and Schizaceæ, newer and "higher" than Osmundaceæ, less perfectly evolved so far as the charac-

ters of the family as a whole are concerned than the Polypodiaceae, and probably older than most of the polypodiaceous genera.

The general structural simplicity of the fronds, reminiscent of the mosses, was once responsible for the opinion that the Hymenophyllaceae were related to the mosses and were the most primitive ferns. The last exponent of this view was Prantl, who held it after it ceased to be reasonable. It is more curious and less reasonable to find Goebel supporting the same opinion as to the gametophyte, even in recent years. The protonema of "*Trichomanes*" is more like that of mosses than is the corresponding structure of "*Hymenophyllum*," and he regards the branched, nonthalloid protonema as the phylogenetically oldest form of the hymenophyllaceous prothallium. However complete the apparent identity of the protonema of "*Trichomanes*" and a moss, it is not evidence of affinity unless the gametophyte has an ancestry distinct from that of the sporophyte, and to a group, the Musci, far aside from the accepted line of fern evolution. The protonema is the least primitive gametophyte in the family, just as the minute fronds of *Microgonium*, which Prantl regarded as the most primitive sporophytes, are really the least so.

The Hymenophyllaceae had fern ancestors. Their evolution as a family was a phenomenon of reduction, on a scale for which there is no parallel among independent (holophytic) vascular plants. On the scale of one small genus we know similar reduction of the leaf tissue in *Leptopteris*. On the scale of one tissue we know aquatics which have lost their stomata. But no other considerable family has lost the tissue differentiation of the plant leaf. And this is a fairly successful family, judged by the area it occupies, and by its wealth of genera and species and individuals. It evidently fits well a set of conditions—high humidity, weak illumination, still air—common, especially in the Tropics. Except as man may destroy its environment by removing the forest, it is not at all a waning family. Its prosperity, with its simplified leaves, throws instructive light on the conditions responsible for the evolution of the ordinary leaf and its tissues.

Within the family reduction continues to be the most interesting phenomenon of general evolution. *Craspedophyllum*, *Microtrichomanes*, *Didymoglossum*, and *Microgonium* are genera in whose evolution reduction in size, correlated with inevitable simplification in form, has been the most conspicuous element. Without transgressing the generic limits I recognize, reduction

of the same kind has been conspicuous in *Mecodium*, *Sphaerocionium*, *Meringium*, *Cephalomanes*, *Didymoglossum*, *Microtrichomanes*, and *Vandeboschia*. Very many species are exceedingly plastic in the same respect, a fact responsible for a very large number of sure synonyms, and for the difficulty of assigning limits to such species as *Vandeboschia radicans*, *Mecodium polyanthos*, all common species of *Crepidomanes*, and most species of *Gonocorpus* and *Selenodesmium*.

The proposal of more than thirty genera, in a family where two have been imagined to suffice, will not be welcomed by those insufficiently acquainted with these plants to understand the propriety of any larger number. Really, there are very few of the thirty-three as to the propriety of which I recognize any question. *Hemicyathus* and *Amphipterum* are maintained because any other course, conserving naturalness, involves worse inconvenience. *Apteropteris* and *Myriodon* are proposed because the plants are too bizarre to go well into the large genera to which they are related; each is in its way unique among vascular plants. *Meringium* could have been left in *Hymenophyllum*; but the separation seems natural, facilitates the picturing of their dispersal and subsequent evolution, and leaves both genera large enough for convenience.

One can easily go farther in the recognition of genera. My predecessors have divided *Trichomanes* and *Flea* more finely, and it will probably be done again. *Microgonium Hookeri* may belong in a genus by itself. *Trichomanes Hildebrandtii* and *Hymenophyllum Levingei*, both unknown to me, are described as peculiar enough perhaps to merit generic status. And a number of far southern species which I include in the cosmopolitan genera are at least very foreign elements there. Thus *Hymenophyllum pectinatum* may become a monotypic genus. *Diplazophyllum* may again be separated from *Mecodium*. And *Hymenophyllum dentatum* is so far from at home in *Meringium* that I abstain from renaming it there, though it belongs nowhere else. *Hymenophyllum Rolandi-Principis* is a generic entity, but may better remain unnamed as such until its fruit may be discovered.

In each of the thirty-three adopted and named genera I have listed the species I know to belong there and believe to be good species. As to the Old World species this listing is almost complete. As a matter of convenience I conclude this treatise with an index of synonyms of *Trichomanes* and *Hyme-*

*nophyllum*, based on Christensen's Index Filicum and its supplements, and intended for use in connection therewith. In this index will be found many such entries as *Vandenboschia* sp., *Mecodium* sp., and *Sphaerocionium* sp. In such cases I abstain from a transfer of specific name because I do not personally know the species in question and, therefore, have no judgment as to the validity of the species, not because of doubt as to its genus. Experience with Oriental named species has shown a surprising proportion which seem to me not to be distinct, and this makes me fear that a general transfer of published names of American species would result in many undesirable synonyms.

## INDEX OF SYNONYMS

## HYMENOPHYLLUM

<i>H. abruptum</i> Hooker.	<i>Mecodium abruptum</i> .
<i>H. acanthoides</i> Ros.	<i>Meringium acanthoides</i> .
<i>H. acerosorum</i> v. d. B.	<i>Mecodium polyanthos</i> .
<i>H. aculeatum</i> Racib.	<i>Meringium denticulatum</i> .
<i>H. aculeolatum</i> v. d. B.	<i>Meringium</i> ?
<i>H. adiantoides</i> v. d. B.	<i>Sphaerocionium</i> sp.
<i>H. aeruginosum</i> Carm.	<i>Sphaerocionium</i> sp.
<i>H. affine</i> Brack.	id.
<i>H. Alfredii</i> Ros.	<i>Mecodium Alfredii</i> .
<i>H. alpinum</i> Col.	<i>Meringium multifidum</i> .
<i>H. alveolatum</i> C. Chr.	id.
<i>H. amabile</i> Morton.	<i>Sphaerocionium</i> sp.
<i>H. andinum</i> v. d. B.	<i>Mecodium andinum</i> .
<i>H. angulosum</i> Christ.	<i>Mecodium angulosum</i> .
<i>H. angustifrons</i> Christ.	<i>Sphaerocionium</i> sp.
<i>H. angustum</i> v. d. B.	<i>Sphaerocionium</i> sp.
<i>H. anisopterum</i> A. Peter.	<i>Sphaerocionium</i> sp.
<i>H. antarcticum</i> Presl.	id.
<i>H. antillense</i> Jenman.	<i>Sphaerocionium antillense</i> .
<i>H. apiculatum</i> Mott.	<i>Mecodium</i> sp.
<i>H. Armstrongii</i> Kirk.	<i>Microtrichomanes</i> ?
<i>H. asperulum</i> Kze.	id.
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<i>H. atrovirens</i> Col.	<i>Mecodium australe</i> ?
<i>H. australe</i> Willd.	<i>Mecodium australe</i> .
<i>H. axillare</i> Sw.	<i>Mecodium axillare</i> .
<i>H. Babindae</i> Watts.	<i>Hymenophyllum antarcticum</i> .
<i>H. badii</i> H. and G.	<i>Mecodium badii</i> .
<i>H. Balansae</i> Fourn.	<i>Mecodium</i> sp.
<i>H. baileyianum</i> Donnan.	<i>Hemiegytheon Baileyianum</i> .
<i>H. Bakeri</i> Copel.	<i>Meringium Bakeri</i> .
<i>H. Baldwinii</i> Eaton.	<i>Callistopteris Baldwinii</i> .
<i>H. Balfourii</i> Baker.	<i>Mecodium fumaroides</i> .



- H. banterianum* Ros.  
*H. barbatum* Baker.  
*H. batuenae* Ros.  
*H. bicolanum* Copel.  
*H. bismarckianum* Christ.  
*H. bixalve* Sw.  
*H. blandum* Racib.  
*H. blumianum* Spr.  
*H. bontocense* Copel.  
*H. borneense* Hooker.  
*H. Boschii* Ros.  
*H. botryoides* v. d. B.  
*H. Bontonii* Baker.  
*H. brachyglossum* A. Br.  
*H. brachypus* Sod.  
*H. brasilianum* Ros.  
*H. breve* Ros.  
*H. brevidens* v. A. v. R.  
*H. brevistipes* Liebm.  
*H. Buchtienii* Ros.  
*H. caespitosum* Gaud.  
*H. enlodictyon* v. d. B.  
*H. campanulatum* Christ.  
*H. capillaceum* Roxb.  
*H. capillare* Desv.  
*H. Cardunculus* C. Chr.  
*H. carnosum* Christ.  
*H. caudatellum* Christ.  
*H. caudiculatum* Mart.  
*H. ceratophylloides* Christ.  
*H. cernuum* Gepp.  
*H. Cherssemani* Baker.  
*H. Chrysotrix* Sturm.  
*H. ciliatum* Sw.  
*H. cincinnatum* Gepp.  
*H. Cimensiae* Copel.  
*H. compactum* Bonap.  
*H. constrictum* Christ.  
*H. constrictum* Hayata.  
*H. contextum* Ros.  
*H. contortum* v. d. B.  
*H. contractile* Sod.  
*H. copelandianum* v. A. v. R.  
*H. corcanum* Nakai.  
*H. corrugatum* Christ.  
*H. corticola* Hooker.  
*H. costaricanum* v. d. B.  
*H. crispato-alatum* Hayata.  
*H. eripatulum* v. d. B.  
*Mecodium imbricatum*.  
*id.*  
*Meringium* sp.  
*Meringium bicolanum*.  
*Mecodium* sp.  
*Meringium bixalve*.  
*Meringium blandum*.  
*Mecodium polyanthos*.  
*Meringium bontocense*.  
*Microtrichomanes palmatifidum*.  
*Meringium holochitum*.  
*Mecodium* sp.  
*Sphaerocionium* sp.  
*Meringium brachyglossum*.  
*id.*  
*Sphaerocionium* sp.  
*Mecodium* sp.  
*Meringium* sp.  
*Mecodium* sp.  
*Sphaerocionium Buchtienii*.  
*Serphyllopsis caespitosa*.  
*Meringium* ?  
*Meringium campanulatum*.  
*Mecodium* sp.  
*Sphaerocionium capillare*.  
*Meringium Cardunculus*.  
*Mecodium* sp.  
*Sphaerocionium* sp.  
*Mecodium caudiculatum*.  
*id.* (?)  
*Amphipterum* sp.  
*Microtrichomanes* ?  
*Sphaerocionium* sp.  
*Sphaerocionium ciliatum*.  
*Meringium* sp.  
*Meringium pachydermicum*.  
*Mecodium fumarioides*.  
*Mecodium constrictum*.  
*Mecodium polyanthos*.  
*Mecodium contextum*.  
*Mecodium contortum*.  
*Sphaerocionium* sp.  
*Mecodium Reinwardtii*.  
*Mecodium Wrightii*.  
*Mecodium corrugatum*.  
*Microtrichomanes nitidulum*.  
*Mecodium costaricanum*.  
*Mecodium crispato-alatum*.  
*Sphaerocionium* sp.

- H. crispatum* Wall.  
*H. crispum* H. B. K.  
*H. cristulatum* Ros.  
*H. Cruegeri* Müller.  
*H. cruentum* Cav.  
*H. cubense* Sturm.  
*H. caucatum* Kze.  
*H. cypressiforme* Lab.  
*H. Darwinii* Hk. f.  
*H. decurrens* Sw.  
*H. dejectum* Baker.  
*H. Delavayi* Christ.  
*H. delicatissimum* Fée.  
*H. deltoideum* C. Chr.  
*H. demissum* Sw.  
*H. Dendritis* Ros.  
*H. densifolium* Phil.  
*H. dentatum* Cav.  
*H. denticulatum* Sw.  
*H. Deplanchei* Mett.  
*H. dichotomum* Blume.  
*H. dichotomum* Cav.  
*H. dichotomum* aliorum.  
*H. dicranotrichum*.  
*H. dilatatum* Sw.  
*H. dimidiatum* Mett.  
*H. dimorphum* Christ.  
*H. dipteroneuron* A. Br.  
*H. discorum* Christ.  
*H. divaricatum* v. d. B.  
*H. Durandii* Christ.  
*H. Dusenii* Christ.  
*H. ectocarpon* Fée.  
*H. edentatum* C. Chr.  
*H. Elberti* Ros.  
*H. elegans* Spr.  
*H. elegantissimum* Fée.  
*H. elegantulum* v. d. B.  
*H. ellipticosorum* v. A. v. R.  
*H. emarginatum* Sw.  
*H. epiphyticum* J. W. Moore.  
*H. erosum* Blume.  
*H. exiguum* Bedd.  
*H. eximium* Kunze.  
*H. exsertum* Wall.  
*H. faktaudicum* Baker.  
*H. farallanense* Hieron.  
*H. fastigiosum* Christ.  
*H. fecundum* v. d. B.  
*H. ferjeense* Brack.  
*Mecodium crispatum*.  
*Sphaerocionium* sp.  
*Mecodium sanguinolentum*.  
*Sphaerocionium Cruegeri*.  
*Hymenoglossum cruentum*.  
*Sphaerocionium* sp.  
*Mecodium caucatum*.  
 id.  
*Mecodium* sp.  
*Sphaerocionium* sp.  
*Hymenophyllopsis dejecta*.  
*Mecodium exsertum*.  
*Sphaerocionium Cruegeri*.  
*Mecodium Humbertii*.  
*Mecodium demissum*.  
*Mecodium Dendritis*.  
*Scorpyllopsis caespitosa*.  
*Meringium* ?  
*Meringium denticulatum*.  
*Hemicyathum Deplanchei*.  
*Mecodium Reinwardtii*.  
*Meringium denticulatum*.  
*Meringium plicatum*.  
*Leptocionium dicranotrichum*.  
*Mecodium dilatatum*.  
*Meringium dimidiatum*.  
*Sphaerocionium* sp.  
*Amphipterum fuscum*.  
*Mecodium paniculiflorum*.  
*Sphaerocionium* sp.  
*Sphaerocionium Durandii*.  
*Scorpyllopsis caespitosa*.  
 ?  
*Meringium edentatum*.  
*Meringium* sp.  
*Sphaerocionium elegans*.  
*Sphaerocionium elegantissimum*.  
*Sphaerocionium elegantulum*.  
*Meringium* sp.  
*Mecodium emarginatum*.  
*Mecodium polyanthum*.  
*Mecodium javanicum*.  
*Didymoglossum exiguum*.  
*Mecodium emarginatum*.  
*Mecodium exsertum*.  
 id.  
*Mecodium* sp.  
*Hymenophyllum barbatum*.  
*Mecodium* sp.  
*Meringium ferjeense*.

- H. fendlerianum* Sturm.  
*H. ferox* v. d. B.  
*H. ferrugineum* Colla.  
*H. Filicula* Bory.  
*H. fimbriatum* J. Sm.  
*H. firmum* v. A. v. R.  
*H. flabellatum* Lab.  
*H. flexile* Makino.  
*H. flexuosum* A. Cunne.  
*H. Focasteri* Ros.  
*H. formosum* Brack.  
*H. Foxworthyi* Copel.  
*H. Francavillei* v. d. B.  
*H. Franklinae* Col.  
*H. fraternum* Harr.  
*H. fuciforme* Sw.  
*H. fucoides* Sw.  
*H. Fuertesii* Brause.  
*H. fujisavense* Nakai.  
*H. fumarioides* Willd.  
*H. Funckii* v. d. B.  
*H. fuscum* v. d. B.  
*H. fusagasugense* Karst.  
*H. Gardneri* v. d. B.  
*H. geluense* Ros.  
*H. Glaziovii* Baker.  
*H. glebarium* Christ.  
*H. Gollmeri* v. d. B.  
*H. gorgoneum* Copel.  
*H. gracilescens* Domin.  
*H. gracillius* Copel.  
*H. gratum* Fée.  
*H. halconense* Copel.  
*H. Hallieri* Ros.  
*H. hamuliferum* v. A. v. R.  
*H. helicoides* Sod.  
*H. hemipterum* Ros.  
*H. Henryi* Baker.  
*H. hibernicum* Brause.  
*H. Herzogii* Ros.  
*H. Hieronymi* C. Chr.  
*H. himalaianum* v. d. B.  
*H. hirsutum* Sw.  
*H. hirtellum* Sw.  
*H. holochilum* C. Chr.  
*H. holotrichum* A. Peter.  
*H. Hosii* Copel.  
*H. Houstonii* Junman.  
*H. Humbertii* C. Chr.  
*H. humboldtianum* Fourn.
- Mecodium fendlerianum*.  
*Mecodium ferox*.  
*Sphaerocionium ferrugineum*.  
*Crepidomanes bipunctatum*.  
*Mecodium fimbriatum*.  
*Meringium firmum*.  
*Mecodium flabellatum*.  
*Mecodium flexile*.  
*Mecodium flexuosum*.  
*Meringium* ?  
*Mecodium imbricatum*.  
*Pleuromanes pallidum*.  
*Sphaerocionium* sp.  
*Sphaerocionium ferrugineum*.  
*Mecodium fimbriatum*.  
*Mecodium* ? (receptacle elongate.)  
*Meringium fucoides*.  
*Sphaerocionium* sp.  
*Mecodium polyanthos*.  
*Mecodium fumarioides*.  
*Mecodium* sp.  
*Amphipterum fuscum*.  
*Sphaerocionium* sp.  
*Mecodium exsertum*.  
*Amphipterum geluense*.  
*Sphaerocionium* sp.  
 ?  
*Mecodium* sp.  
*Meringium gorgoneum*.  
 id.  
*Mecodium polyanthos*.  
 ?  
*Meringium pachydermicum*.  
*Meringium* sp.  
*Meringium halochilum*.  
*Mecodium* sp.  
*Sphaerocionium hemipterum*.  
*Hymenophyllum barbatum*.  
*Meringium* ?  
 id. -  
*Meringium* sp.  
*Mecodium polyanthos*.  
*Sphaerocionium hirsutum*.  
*Sphaerocionium hirtellum*.  
*Meringium holochilum*.  
*Sphaerocionium* sp.  
*Meringium Hosii*.  
 id. (?) (sterile.)  
*Mecodium Humbertii*.  
*Mecodium* sp.

- H. hygrometricum* Desv.  
*H. imbricatum* Blume.  
*H. inaequale* Desv.  
*H. integrum* v. d. B.  
*H. intercalatum* Christ.  
*H. interruptum* Kze.  
*H. intricatum* v. d. B.  
*H. involueratum* Copel.  
*H. Jamesoni* Hooker.  
*H. japonicum* Miq.  
*H. javanicum* Spr.  
*H. johoreense* Holttum.  
*H. Junghuhnii* v. d. B.  
*H. kaieicurum* Jenman.  
*H. karstenianum* Sturm.  
*H. kerianum* Watts.  
*H. khasianum* Baker.  
*H. klabatense* Christ.  
*H. kohautianum* Presl.  
*H. Kuhnii* C. Chr.  
*H. Kurzii* Prantl.  
*H. laciniosum* Christ.  
*H. laminautum* Copel.  
*H. lanatum* Fée.  
*H. lanceolatum* H. and A.  
*H. latilobum* Bonap.  
*H. Ledermannii* Brause.  
*H. Lehmanni* Hieron.  
*H. leptocarpum* Copel.  
*H. leptodictyon* K. Müller.  
*H. LeRatii* Ros.  
*H. Loringii* Clarke.  
*H. L'Hermierii* Mett.  
*H. Limninghii* v. d. B.  
*H. Lindeni* Hooker.  
*H. Lindigii* Mett.  
*H. lindsaeoides* Baker.  
*H. linearis* Sw.  
*H. lingganum* v. A. v. R.  
*H. Lobbii* Moore.  
*H. longifolium* v. A. v. R.  
*H. lophocarpum* Col.  
*H. Lyallii* Hooker f.  
*H. Margillierayi* Copel.  
*H. macrocarpum* v. d. B.  
*H. macroglossum* v. d. B.  
*H. macrosorum* v. A. v. R.  
*H. macrothecum* Fée.  
*H. magellanicum* Willd.  
*H. Malingii* Mett.  
*Sphaerocionium hygrometricum*.  
*Mecodium imbricatum*.  
*Mecodium inaequale*.  
*Mecodium polyanthos*.  
*Sphaerocionium* sp.  
*Sphaerocionium interruptum*.  
*Mecodium intricatum*.  
*Mecodium involueratum*.  
*Ruscia Jamesoni*.  
*Hymenophyllum barbatum*.  
*Mecodium javanicum*.  
*Microrickomanes johorensis*.  
*Mecodium Junghuhnii*.  
 ?  
*Sphaerocionium* sp.  
*Meringium kerianum*.  
*Hymenophyllum barbatum*.  
*Meringium klabatense*.  
*Mecodium* sp.  
*Mecodium Kuhnii*.  
*Meringium holochilum*.  
*Mecodium nigricans*.  
*Amphipterum laminautum*.  
*Sphaerocionium lanatum*.  
*Sphaerocionium lanceolatum*.  
*Mecodium latidum*.  
*Amphipterum Ledermannii*.  
*Mecodium* sp.  
*Meringium penangianum*.  
*Mecodium emarginatum*.  
*Mecodium LeRatii*.  
 id. ?  
*Mecodium* sp.  
*Mecodium fumarioides*.  
*Sphaerocionium* sp.  
*Sphaerocionium* sp.  
*Sphenomeris odontolabia*.  
*Sphaerocionium linearis*.  
*Meringium holochilum*.  
*Meringium Lobbii*.  
*Mecodium longifolium*.  
*Mecodium sanguinolentum*.  
*Sphaerocionium Lyallii*.  
*Meringium Macgillivrayi*.  
*Mecodium badium*.  
*Meringium macroglossum*.  
*Meringium macrosorum*.  
*Mecodium macrothecum*.  
*Meringium magellanicum*.  
*Apteropteris Malingii*.

- H. marginatum* H. and G.  
*H. Marlothii* Brause.  
*H. Mazei* Vourn.  
*H. megalocarpum* Col.  
*H. melanochetias* Col.  
*H. Merrillii* Christ.  
*H. meyenianum* Copel.  
*H. micans* Christ.  
*H. micranthum* v. d. B.  
*H. microcarpum* Desv.  
*H. microchitum* v. d. B.  
*H. microphyllum* Mett.  
*M. microcarpum* v. d. B.  
*H. millefolium* Schl. and Cham.  
*H. minus* A. Rich.  
*H. mirificum* Morton.  
*H. mnioides* Baker.  
*H. modestum* v. d. B.  
*H. montanum* Kirk.  
*H. Moorei* Baker.  
*H. multifidum* Sw.  
*H. multiflorum* Ros.  
*H. myriocarpum* Hooker.  
*H. nanum* Sod.  
*H. Neesii* Hooker.  
*H. nigrescens* Liebm.  
*H. nitens* R. Br.  
*H. nitiduloides* Copel.  
*H. notabile* Péc.  
*H. nutantifolium* v. A. v. R.  
*H. obtusum* H. and A.  
*H. odontophyllum* Copel.  
*H. oligocarpum* Col.  
*H. oligosorum* Makino.  
*H. omeiense* Christ.  
*H. ooides* Müller and Baker.  
*H. opacum* Copel.  
*H. orbiganum* v. d. B.  
*H. osmundoides* v. d. B.  
*H. ovatum* Copel.  
*H. oxyodon* Baker.  
*H. pachydermicum* Cesati.  
*H. palmatum* v. d. B.  
*H. palmenae* Ros.  
*H. paniculiflorum* Presl.  
*H. pannosum* Christ.  
*H. pantotactum* v. A. v. R.  
*H. parvifolium* Baker.  
*H. parallellocarpum* Hayata.  
*H. parvulum* C. Chr.  
*Craspedophyllum marginatum*.  
*Sphaerocionium Marlothii*.  
*Mecodium* sp.  
*Mecodium demission*.  
*Microtrichomanes* (?) *Armstrongii*.  
*Meringium Merrillii*.  
*Meringium meyenianum*.  
*Mecodium* sp.  
*Mecodium javanicum*.  
*Sphaerocionium microcarpum*.  
*Mecodium polyanthos*.  
*Mecodium* sp.  
*Mecodium polyanthos*.  
*Mecodium* sp. (*polyanthos* ?)  
*id.* ?  
*Buesia mirifica*.  
*Mecodium mnioides*.  
*Mecodium emarginatum*.  
*Mecodium montanum*.  
*Hymenophyllum pumilum*.  
*Meringium multifidum*.  
*Mecodium multiflorum*.  
*Mecodium myriocarpum*.  
*id.*  
*Meringium denticulatum*.  
*Mecodium nigricans*.  
*Mecodium flabellatum*.  
*Mecodium nitiduloides*.  
*?*  
*Meringium* sp.  
*Sphaerocionium obtusum*.  
*Myriodon odontophyllum*.  
*Meringium multifidum*.  
*Mecodium Wrightii*.  
*Hymenophyllum barbatum*.  
*Mecodium ooides*.  
*Mecodium opacum*.  
*Sphaerocionium* sp.  
*Mecodium polyanthos*.  
*Meringium ovatum*.  
*Hymenophyllum barbatum*.  
*Meringium pachydermicum*.  
*Microtrichomanes parvulum*.  
*Sphaerocionium palmense*.  
*Mecodium paniculiflorum*.  
*Sphaerocionium* sp.  
*Mecodium polyanthos*.  
*Microgonium* sp.  
*Mecodium polyanthos*.  
*Mecodium* sp.

- H. parvum* C. Chr.  
*H. paucicarpum* Jenman.  
*H. pectinatum* Cav.  
*H. pedicularifolium* Cesati.  
*H. petatum* Desv.  
*H. penangianum* Matthew and Christ.  
*H. pendulum* Bory.  
*H. perfoliatum* Copel.  
*H. perparvulum* v. A. v. R.  
*H. physocarpum* Christ.  
*H. piliferum* C. Chr.  
*H. pilosissimum* C. Chr.  
*H. pilosum* v. A. v. R.  
*H. pleiocarpum* v. A. v. R.  
*H. plicatum* Kaulf.  
*H. plumosum* Kaulf.  
*H. Psilaneii* Tard. and C. Chr.  
*H. pollenianum* Ros.  
*H. polyanthos* Sw.  
*H. polyanthum* Hooker.  
*H. polychilum* Col.  
*H. polyodon* Baker.  
*H. Poolii* Baker.  
*H. praetervisum* Christ.  
*H. Preslii* Ros.  
*H. prionema* Kunze.  
*H. procerum* v. d. B.  
*H. productoides* J. W. Moore.  
*H. productum* Kze.  
*H. prostratum* Hooker.  
*H. pseudo-tunbridgenae* Watts.  
*H. pulcherrimum* Col.  
*H. pulchrum* Copel.  
*H. pumilio* Ross.  
*H. pumilum* C. Moore.  
*H. punctisorum* Ros.  
*H. pusillum* Col.  
*H. pyenocarpum* v. d. B.  
*H. pygmaeum* Col.  
*H. pyramidalatum* Desv.  
*H. pyriforme* v. d. B.  
*H. quadrifidum* Phil.  
*H. radikanum* K. Müller.  
*H. Ramosii* Copel.  
*H. rarum* R. Br.  
*H. recurvum* Gaud.  
*H. reductum* Copel.  
*H. Reinwardtii* v. d. B.  
*H. remotipinnu* Bonap.
- Mecodium fumarioides.*  
*Mecodium* (teste Morton.)  
 id.  
*Meringium* sp.  
 id.  
*Meringium penangianum.*  
*Sphaeroclonium capillare.*  
 id.  
*Meringium* sp.  
*Mecodium thuidium.*  
 ?  
*Sphaeroclonium pilosissimum.*  
*Meringium pachydermicum.*  
*Mecodium crispatum.*  
*Meringium plicatum.*  
*Sphaeroclonium plumosum.*  
 id. (?)  
*Meringium pollenianum.*  
*Mecodium polyanthos.*  
*Callistopteris polyantha.*  
*Mecodium demissum.*  
 id. (?)  
*Sphaeroclonium Poolii.*  
*Meringium praetervisum.*  
 (nomen inconditionum)  
 id.  
*Sphaeroclonium* sp.  
*Mecodium productoides.*  
*Mecodium productum.*  
*Mecodium prostratum.*  
*Hymenophyllum affine.*  
*Mecodium pulcherrimum.*  
*Meringium pulchrum.*  
 id.  
 id.  
*Mecodium polyanthos.*  
*Hymenophyllum revolutum.*  
*Mecodium polyanthos.*  
*Hymenophyllum revolutum.*  
*Sphaeroclonium pyramidalatum.*  
*Meringium bivalet.*  
*Meringium magellanicum.*  
*Sphaeroclonium radikanum.*  
*Meringium Ramosii.*  
*Mecodium rarum.*  
*Mecodium recurvum.*  
*Meringium reductum.*  
*Mecodium Reinwardtii.*  
*Mecodium uronioides.*

- H. reniforme* Hooker.  
*H. retusilobum* Hayata.  
*H. revolutum* Col.  
*H. ricciaefolium* Bory.  
*H. Rimbachii* Sod.  
*H. ringens* Christ.  
*H. rinkiense* Christ.  
*H. Rolandi-Principis* Ros.  
*H. Rosenstockii* Brause.  
*H. rubellum* Ros.  
*H. rufescens* Kirk.  
*H. rufifolium* v. A. v. R.  
*H. rufifrons* v. A. v. R.  
*H. rufum* Fée.  
*H. rugosum* C. Chr. and Skottsberg.  
*H. ruizianum* Kze.  
*H. sabinaefolium* Baker.  
*H. salakense* Racib.  
*H. samoense* Baker.  
*H. sampanianum* Brade et Ros.  
*H. sanguinolentum* Sw.  
*H. scabrum* A. Rich.  
*H. secundum* H. and G.  
*H. semibivale* H. and G.  
*H. semissimum* Copel.  
*H. semiglabrum* Ros.  
*H. sericeum* Sw.  
*H. Serra* Presl.  
*H. serrulatum* C. Chr.  
*H. seselifolium* Presl.  
*H. shirleyanum* Domin.  
*H. sibthorpioides* Mett.  
*H. siliquosum* Christ.  
*H. Silveirae* Christ.  
*H. sinuatum* Hooker.  
*H. Skottsbergii* C. Chr.  
*H. Smithii* Hooker.  
*H. Sodiroi* C. Chr.  
*H. sororium* v. d. B.  
*H. spectabile* Mett.  
*H. sphaerocarpum* v. d. B.  
*H. spicatum* Christ.  
*H. splendidum* v. d. B.  
*H. Sprucci* Baker.  
*H. Steerei* C. Chr.  
*H. streptophyllum* Fourn.  
*H. subdenissimum* Christ.  
*H. subdimidiatum* Ros.  
*H. subfirmum* v. A. v. R.  
*H. substellatum* Cesati.  
*Mecodium reniforme*.  
*Mecodium* sp.  
 id.  
*Meringium tenellum*.  
*Mecodium* sp.  
*Meringium* ?  
*Mecodium rinkiense*.  
*Gen. novum* ined.  
*Meringium Rosenstockii*.  
*Meringium rubellum*.  
*Mecodium rufescens*.  
*Meringium* sp.  
*Meringium* sp.  
*Sphaerocionium rufum*.  
 id.  
*Sphaerocionium ruizianum*.  
*Meringium acanthoides*.  
*Mecodium salakense*.  
*Mecodium samoense*.  
*Sphaerocionium sampanianum*.  
*Mecodium sanguinolentum*.  
*Mecodium scabrum*.  
*Meringium secundum*.  
*Mecodium rarum*.  
*Meringium penangianum*.  
*Sphaerocionium semiglabrum*.  
*Sphaerocionium sericeum*.  
*Meringium secundum*.  
*Meringium meyenianum*.  
 id. ?  
*Mecodium samoense*.  
*Microtrichomanes parvulum*.  
*Mecodium siliquosum*.  
*Sphaerocionium* sp.  
 id.  
*Mecodium* sp.  
*Meringium meyenianum*.  
*Buesia Sodiroi*.  
*Mecodium imbricatum*.  
*Sphaerocionium spectabile*.  
*Mecodium polyanthos*.  
 id.  
*Sphaerocionium splendidum*.  
*Sphaerocionium* sp.  
*Mecodium semibratum*.  
*Mecodium* sp.  
*Mecodium polyanthos*.  
*Meringium* ?  
*Meringium firmum*.  
*Meringium Lobbia*.

- H. subobtusum* Ros.  
*H. subrigidum* Christ.  
*H. subrotundum* v. A. v. R.  
*H. subtilissimum* Kunze.  
*H. tablaizense* Christ.  
*H. taliabense* v. A. v. R.  
*H. tasmanicum* v. d. B.  
*H. tenellum* Kuhn.  
*H. tenerrimum* v. d. B.  
*H. tenerum* v. d. B.  
*H. Thomassetii* C. H. Wright.  
*H. thuidium* Harr.  
*H. todjumbucense* Kjellberg.  
*H. tomentosum* Kze.  
*H. torquescens* v. d. B.  
*H. torricellianum* v. A. v. R.  
*H. tortuosum* H. and G.  
*H. trapezoidale* Liebm.  
*H. Treubii* Kacih.  
*H. Trianae* Hieron.  
*H. triangulare* Baker.  
*H. trichocaulon* Phil.  
*H. trichomanoides* v. d. B.  
*H. trichophyllum* H. B. K.  
*H. truncatum* Col.  
*H. tunbridgense* (L.) Sw.  
*H. Ulei* Christ and Gies.  
*H. uncinatum* Sim.  
*H. undulatum* Sw.  
*H. unilaterale* Bory.  
*H. Urbani* Brause.  
*H. vacillans* Christ.  
*H. valvatum* H. and G.  
*H. veronicoides* C. Chr.  
*H. villosum* Col.  
*H. vincentinum* Baker.  
*H. violaceum* Meyen.  
*H. viride* Ros.  
*H. vittatum* Copel.  
*H. Walleri* Maiden and Betcher.  
*H. Wercklei* Christ.  
*H. Wrightii* v. d. B.  
*H. zealandicum* v. d. B.  
*H. zollingerianum* Kunze.
- Sphaeroclonium subobtusum*.  
*Sphaeroclonium subrigidum*.  
*Meringium denticulatum*.  
*Sphaeroclonium ferrugineum*.  
*Mecodium tablaizense*.  
*Meringium pachydermicum*.  
*Mecodium australe*.  
*Meringium tenellum*.  
*Sphaeroclonium* sp.  
*Mecodium* sp.  
 id.  
*Mecodium thuidium*.  
*Mecodium* sp.  
*Sphaeroclonium tomentosum*.  
 id.  
*Meringium* sp.  
*Meringium tortuosum*.  
*Mecodium* sp.  
*Mecodium Treubii*.  
*Mecodium Trianae*.  
*Meringium triangulare*.  
 ?  
*Mecodium* sp.  
*Sphaeroclonium trichophyllum*.  
*Meringium multifidum*.  
 id.  
*Sphaeroclonium* sp.  
 id.  
*Mecodium undulatum*.  
*Hymenophyllum peltatum*.  
*Sphaeroclonium* sp.  
 ?  
*Sphaeroclonium valvatum*.  
*Mecodium veronicoides*.  
*Mecodium villorum*.  
*Mecodium macrothecum*.  
*Meringium mycenianum*.  
 id. ?  
*Meringium vittatum*.  
*Mecodium Walleri*.  
*Sphaeroclonium Wercklei*.  
*Mecodium Wrightii*.  
*Hymenophyllum revolutum*.  
*Amphipterum fuscum*.

## TRICHOMANES

- T. abrotanifolium* v. d. B.  
*T. acedens* Ph.  
*T. acrosorum* Copel.  
*T. acutifolium* Ching.
- Vandenboschia* sp.  
 id.  
*Cephalomanes acrosorum*.  
*Crepidomanes* sp.



<i>T. acuto-obtusum</i> Hayata.	<i>Crepidomanes</i> Makinoi.
<i>T. acutum</i> Presl.	<i>Pleuromanes</i> oculatum.
<i>T. adscendens</i> Kze.	id.
<i>T. africanum</i> Christ.	<i>Vandenboschia</i> ?
<i>T. alagense</i> Christ.	<i>Gonocormus</i> alagensis.
<i>T. alatum</i> Sw.	id.
<i>T. alternans</i> Carr.	<i>Crepidopteris</i> endlicheriana.
<i>T. amabile</i> Nakai.	<i>Vandenboschia</i> radicans.
<i>T. amazonicum</i> Christ.	id.
<i>T. anadromum</i> Ros.	id.
<i>T. angustatum</i> Carm.	<i>Macroglena</i> ?
<i>T. angustimarginatum</i> Bonap.	<i>Macroglena</i> angustimarginata.
<i>T. Andersii</i> Parker.	id.
<i>T. aphleboides</i> Christ.	<i>Vandenboschia</i> aphleboides.
<i>T. apiculare</i> Fourn.	<i>Crepidopteris</i> sp.
<i>T. apifolium</i> Pr.	<i>Callistopteris</i> apifolia.
<i>T. arbuscula</i> Desv.	id.
<i>T. Asae-Grayi</i> v. d. B.	<i>Macroglena</i> Asae-Grayi.
<i>T. asplenoides</i> Presl.	<i>Cephalomanes</i> oblongifolium.
<i>T. assimile</i> Mett.	<i>Gonocormus</i> ?
<i>T. Aswijkii</i> Ruedb.	<i>Microtrichomanes</i> sp.
<i>T. atrovirens</i> Kuhn.	<i>Cephalomanes</i> atrovirens.
<i>T. auriculatum</i> Bl.	<i>Vandenboschia</i> auriculata.
<i>T. axillare</i> Sod.	<i>Vandenboschia</i> sp.
<i>T. badium</i> Fourn.	id.
<i>T. Baldwini</i> Copel.	<i>Callistopteris</i> Baldwini.
<i>T. barkhamianum</i> Baker.	<i>Didymoglossum</i> ?
<i>T. barnardianum</i> Bailey.	<i>Crepidomanes</i> ?
<i>T. batrachoglossum</i> Copel.	<i>Selenodesmium</i> batrachoglossum.
<i>T. bauerianum</i> Endl.	<i>Callistopteris</i> baueriana.
<i>T. beccarianum</i> Cesati.	<i>Microgonium</i> beccarianum.
<i>T. Beckeri</i> Krause.	<i>Vandenboschia</i> sp.
<i>T. bicornis</i> Hooker.	id.
<i>T. bilabiatum</i> Nees et Bl.	<i>Crepidomanes</i> bilabiatum.
<i>T. bilobatum</i> v. A. v. R.	<i>Crepidomanes</i> bilobatum.
<i>T. bimarginatum</i> v. d. B.	<i>Microgonium</i> bimarginatum.
<i>T. bipunctatum</i> Poir.	<i>Crepidomanes</i> bipunctatum.
<i>T. birmanicum</i> Badd.	<i>Vandenboschia</i> radicans.
<i>T. blopharistomum</i> Copel.	<i>Nesopteris</i> thysanostomum.
<i>T. Boivini</i> v. d. B.	<i>Selenodesmium</i> (?)
<i>T. Bonapartei</i> C. Chr.	<i>Gonocormus</i> sp.
<i>T. bonincolum</i> Nakai.	<i>Gonocormus</i> sp.
<i>T. boninense</i> Koidzumi.	<i>Crepidomanes</i> sp.
<i>T. bornense</i> v. A. v. R.	<i>Cephalomanes</i> singaporianum.
<i>T. boryanum</i> Kunze.	<i>Cephalomanes</i> boryanum.
<i>T. botryoides</i> Kaulf.	<i>Feca</i> botryoides.
<i>T. brachyblastos</i> Mett.	<i>Vandenboschia</i> sp.
<i>T. Bradei</i> Christ.	<i>Vandenboschia</i> sp.
<i>T. brevipes</i> Baker.	<i>Crepidomanes</i> brevipes.
<i>T. Brooksii</i> Copel.	<i>Gonocormus</i> sp.

- T. caespitosum* Hooker.  
*T. calvescens* v. d. B.  
*T. capillaceum* L.  
*T. capillatum* Taschner.  
*T. cartilagineum* Vieill. et Pancher.  
*T. caudatum* Brack.  
*T. cellulatum* Kl.  
*T. Chevalieri* Christ.  
*T. Christii* Copel.  
*T. Cocos* Christ.  
*T. cognatum* Cesati.  
*T. Colensoi* Hooker f.  
*T. compactum* v. A. v. R.  
*T. concinnum* Mett.  
*T. corcovadense* v. d. B.  
*T. cordifolium* Alston.  
*T. corticola* Bedd.  
*T. crassipilis* Weatherby.  
*T. craspedoneurum* Copel.  
*T. crassum* Copel.  
*T. crinitum* Sw.  
*T. crispum* L.  
*T. cristatum* Kaulf.  
*T. cultratum* Baker.  
*T. Cumingii* C. Chr.  
*T. cuneatum* Christ.  
*T. cupressifolium* Hayata.  
*T. cupressoides* Desv.  
*T. Currantii* Weatherby.  
*T. Curtii* Ros.  
*T. cuspidatum* Willd.  
*T. cyrtotheca* Hilleb.  
*T. dacylites* Sod.  
*T. daguense* Weatherby.  
*T. duvalliioides* Gaud.  
*T. debile* v. d. B.  
*T. delicatum* v. d. B.  
*T. densinervium* Copel.  
*T. dentatum* v. d. B.  
*T. denticulatum* Baker.  
*T. diaphanum* H. B. K.  
*T. dichotomum* Kze.  
*T. diffusum* Bl.  
*T. digitatum* Sw.  
*T. diversifrons* Mett.  
*T. draytonianum* Brack.  
*T. elegans* Rich.  
*T. elongatum* A. Cunn.  
*T. endlicherianum*.  
*T. englerianum* Brause.  
*Serpytloopsis caespitosa*.  
*Sphaeroclonium Lyallii*.  
*Vandenboschia capillacea*.  
*Crepidomanes bilabiatum*.  
*Sclerodesmium dentatum*.  
*Macroglena cundata*.  
*Vandenboschia* sp.  
*Vandenboschia* ?  
*Crepidomanes Christii*.  
*Vandenboschia* sp.  
*Microgonium beccarianum*.  
*Vandenboschia Colensoi*.  
*Macroglena compacta*.  
*Crepidopteris humile*.  
 id.  
*Didymoglossum cordifolium*.  
*Microtrichomanes nitidulum*.  
 id.  
*Microgonium craspedoneurum*.  
*Cephalomanes*.  
 id.  
 id.  
 id.  
*Microgonium cultratum*.  
*Abrodictyum Cumingii*.  
*Microtrichomanes Francii*.  
*Vandenboschia latifrons*.  
*Sclerodesmium cupressoides*.  
 id.  
*Didymoglossum lincolatum*.  
*Microgonium cuspidatum*.  
*Vandenboschia cyrtotheca*.  
*Vandenboschia* sp.  
 id.  
*Vandenboschia duvalliioides*.  
*Vandenboschia* sp.  
 id.  
*Cephalomanes densinervium*.  
*Sclerodesmium dentatum*.  
*Meringium Bakeri*.  
*Vandenboschia diaphana*.  
*Microtrichomanes dichotomum*.  
*Gonocormus diffusus*.  
*Microtrichomanes digitatum*.  
*Feca diversifrons*.  
*Vandenboschia draytonianum*.  
*Davalliopsis elegans*.  
*Sclerodesmium elongatum*.  
*Crepidopteris endlicheriana*.  
*Sclerodesmium* ?

- T. erectum* Brack.  
*T. eriophorum* v. d. B.  
*T. erosum* Willd.  
*T. exiguum* Baker.  
*T. exsectum* Kze.  
*T. extravagans* Copel.  
*T. fallax* Christ.  
*T. Fargesii* Christ.  
*T. ferrugineum* Fourn.  
*T. filiculoides* Christ.  
*T. fimbriatum* Backh.  
*T. flabellatum* v. d. B.  
*T. flavo-fuscescens* v. d. B.  
*T. Foersteri* Ros.  
*T. fontanum* Lindb.  
*T. formosum* Yabe.  
*T. Foxworthii* C. Chr.  
*T. Francii* Christ.  
*T. Frappieri* Cord.  
*T. Fraseri* Jenman.  
*T. fruticosum* Jenm.  
*T. fulgens* C. Chr.  
*T. furcatum* v. d. B.  
*T. Galeottii* Fourn.  
*T. Gardneri* v. d. B.  
*T. gemmatum* J. Sm.  
*T. Giesenhagenii* C. Chr.  
*T. giganteum* Bory.  
*T. Godmani* Hooker.  
*T. goebelianum* Gies.  
*T. Gostzii* Hieron.  
*T. gracile* v. d. B.  
*T. gracillimum* Copel.  
*T. grande* Copel.  
*T. guianense* Sturm.  
*T. Hartii* Baker.  
*T. Harveyi* Cart.  
*T. henzeianum* Parish.  
*T. Herzogii* Ros.  
*T. heterophyllum* HBW.  
*T. Hieronymi* Brause.  
*T. Hildebrandtii* Kuhn.  
*T. hispidum* Mett.  
*T. holopterum* Kze.  
*T. Hookeri* Presl.  
*T. Hosii* Baker.  
*T. hostmannianum* Kunze.  
*T. Huberi* Christ.  
*T. humile* Forster.  
*T. hymenophylloides* v. d. B.  
*Crepidopteris Endlicheriana*.  
*id.*  
*Microgonium erosum*.  
*Didymoglossum exiguum*.  
*Vandenboschia exsecta*.  
*Selenodesmium extravagans*.  
*Vandenboschia fallax*.  
*Vandenboschia sp.*  
*Selenodesmium dentatum* (?)  
*Crepidopteris humile*.  
*id.*  
*Microtrichomanes sp.*  
*Macroglena flavo-fusca*.  
*Cephalomanes sp.*  
*Didymoglossum fontanum*.  
*Crepidomanes latemarginale*.  
*Pleuromanes pallidum*.  
*Microtrichomanes Francii*.  
 ?  
*Didymoglossum sp.*  
*Didymoglossum sp.*  
*Microgonium sp.*  
*id.*  
*id.*  
*id.*  
*Macroglena gemmata*.  
*Didymoglossum sp.*  
*Vandenboschia sp.*  
*Didymoglossum Petersii*.  
*Didymoglossum sp.*  
*Vandenboschia sp.*  
*Gonocarpus sp.*  
*Crepidopteris gracillima*.  
*Nesopteris grandis*.  
*id.*  
*Vandenboschia ?*  
*Nesopteris intermedia*.  
*Microgonium henzeianum*.  
*Vandenboschia Herzogii*.  
*Foca heterophylla*.  
*Meringium sp.*  
*Microgonium ?*  
*Nesopteris superba*.  
*id.*  
*Microgonium Hookeri*.  
*Meringium penangianum*.  
*id.*  
*id.*  
*Crepidopteris humile*.  
*Vandenboschia hymenophylloides*.

- T. hymenoides* Hedwig.  
*T. hypnoides* Christ.  
*T. ignobile* Cesati.  
*T. imbricatum* Sod.  
*T. infundibulare* v. A. v. R.  
*T. Ingae* C. Chr.  
*T. insignis* Bedd.  
*T. intermedium* v. d. B.  
*T. intramarginale* H. and G.  
*T. javanicum* Bl.  
*T. johnstonense* Bailey.  
*T. junceum* Christ.  
*T. jurgermannioides* Fourm.  
*T. kalamocarpum* Hayata.  
*T. Kalbreyeri* Baker.  
*T. kupplerianum* Sturm.  
*T. Killipii* Weatherly.  
*T. Kingii* Copel.  
*T. Kirkii* Hooker.  
*T. Kraussii* H. and G.  
*T. Krugii* Christ.  
*T. Kurzii* Bedd.  
*T. lachetum* Jenman.  
*T. laetum* v. d. B.  
*T. lambertianum* Hk.  
*T. lasiophyllum* v. A. v. R.  
*T. latcalatum.* (v. d. B., *Didymoglossum*.)  
*T. latemarginale* Eaton.  
*T. latifrons* v. d. B.  
*T. latilabiatum* E. Brown.  
*T. latipinnum* Copel.  
*T. latisectum* Christ.  
*T. Lauterbachii* Christ.  
*T. laxum* Kl.  
*T. Ledermanni* Brause.  
  
*T. Lehmannii* Hieron.  
*T. Leuormandi* v. d. B.  
  
*T. Leptophyllum* A. Cunn.  
*T. levisimum* Fée.  
*T. libericensis* Copel.  
*T. Lindigii* Fourm.  
*T. lineolatum* Hooker.  
*T. linkinense* Yabe.  
*T. longicollum* v. d. B.  
*T. longifrons* Nakai.  
*T. longilabiatum* Bonap.  
*T. lucens* Sw.  
*T. ludovicianum* Ros.  
  
*Didymoglossum hymenoides.*  
*Vandenboschia* sp.  
*Nesopteris superba.*  
*id.*  
*Cephalomanes* sp.  
*Vandenboschia Ingae.*  
*Crepidomanes* sp.  
*Nesopteris intermedia.*  
*Crepidomanes intramarginale.*  
*Cephalomanes javanicum.*  
*Vandenboschia johnstonensis.*  
*Vandenboschia* sp.  
*Crepidopteris Viillardii.*  
*Vandenboschia radicans.*  
*id.*  
*Didymoglossum* sp.  
*id.*  
*Cephalomanes Kingii.*  
*Crepidomanes vel Microgenium.*  
*Didymoglossum Kraussii.*  
*Selenodesmium* sp.  
*Crepidomanes latemarginale.*  
*Didymoglossum* sp.  
*Macroglena laeta.*  
*id.*  
*Meringium* ?  
*Crepidomanes latcalatum.*  
  
*Crepidomanes latemarginale.*  
*Vandenboschia latifrons.*  
*Gonocormus latilabiatum.*  
*Selenodesmium obscurum.*  
*Vandenboschia* sp.  
*Crepidopteris humile.*  
*id.*  
*Cephalomanes* sp. (prob. *C. atrovi-*  
*rens*.)  
*Didymoglossum* sp.  
*Crepidomanes* ? vide sub *Micro-*  
*genium.*  
*Macroglena stricta.*  
  
*?*  
*Didymoglossum libericensis.*  
*id.*  
*Didymoglossum lineolatum.*  
*Vandenboschia radicans.*  
*Selenodesmium longicollum.*  
*Vandenboschia* sp.  
*? Gonocormus* ?  
*id.*  
*id.*

- T. Lueraschii* F. v. M.  
*T. Lyallii* Hooker f.  
*T. Macgillivrayi* Baker.  
*T. maeilentum* v. d. B.  
*T. madagascariense* Moore.  
  
*T. Majorae* Watts.  
*T. Makinoi* C. Chr.  
*T. malacense* Brause.  
*T. mandioctanum* Raddi.  
*T. Mannii* Hooker.  
*T. Martinezii* Ravicosa.  
*T. Martiusii* Presl.  
*T. Matthiae* Christ.  
*T. maximum* Bl.  
*T. megistostomum* Copel.  
*T. meifolium* Bory.  
*T. melanopus* Baker.  
*T. melanotrichum* Schlecht.  
*T. membranaceum* L.  
*T. Merrillii* Copel.  
*T. Mettenii* C. Chr.  
*T. meyenianum* v. d. B.  
*T. micayense* Hier.  
*T. microchitum* Baker.  
*T. microclitum* Copel.  
*T. Milbracii* Brause.  
*T. Mitrei* v. d. B.  
*T. mindorense* Christ.  
*T. minimum* v. A. v. R.  
*T. minutissimum* v. A. v. R.  
*T. minutum* Bl.  
*T. Miyakei* Yabe.  
*T. montanum* Hooker.  
*T. Nasenii* Lindm.  
*T. Motleyi* v. d. B.  
*T. ntusolense* Brause.  
*T. myriocuron* Lindm.  
*T. naseanum* Christ.  
*T. Neumannii* Kuhn and Lueras.  
*T. nipponicum* Nakai.  
*T. nitidulum* v. d. B.  
*T. novo-guineense* Brause.  
*T. nummularium* C. Chr.  
*T. Nymani* Christ.  
*T. obscurum* Bl.  
*T. ophaleodes* C. Chr.  
*T. opacum* v. d. B.  
*T. orbiculare* Christ.  
*T. orientale* C. Chr.  
*T. ornatulum* v. d. B.  
  
*Macroglena lacta*.  
*Sphaerocentrum Lyallii*.  
*Meringium Macgillivrayi*.  
*id.*  
*Cephalomanes madagascariense* v. d. B.  
*Crepidomanes* sp.  
*Crepidomanes Makinoi*.  
*Cephalomanes* sp.  
*Selenodesmium mandioctanum*.  
*Gonocormus* sp.  
*Vandenboschia* sp.  
*id.*  
*Microtrichomanes* sp.  
*Vandenboschia maxima*.  
*Crepidomanes megistostomum*.  
*Macroglena meifolia*.  
*Didymoglossum melanopus*.  
*Vandenboschia* sp.  
*Lecaniam membranaceum*.  
*Macroglena setacea*.  
*Vandenboschia* ?  
*Meringium meyenianum*.  
*id.*  
*Macodium polyanthos*.  
*Crepidomanes Christii*.  
*Vandenboschia* sp.  
*Macroglena caudata*.  
*Microgonium mindorense*.  
*Crepidomanes bilobatum*.  
*Microgonium beccarianum*.  
*Gonocormus minutus*.  
*Vandenboschia* sp.  
*Didymoglossum Robinsonii*.  
*Didymoglossum Mosonii*.  
*Microgonium Motleyi*.  
*Gonocormus minutus*.  
*Didymoglossum myriocuron*.  
*Vandenboschia radicans*.  
*Crepidopteris eudichleriana*.  
*Vandenboschia* sp.  
*Microtrichomanes nitidulum*.  
*Gonocormus* ?  
*Didymoglossum nummularium*.  
*Crepidomanes Nymani*.  
*Selenodesmium obscurum*.  
*Microgonium ophaleodes*.  
*id.*  
*Didymoglossum* sp.  
*Vandenboschia radicans*.  
*id.*

- T. osmundoides* DC.  
*T. pabatianum* K. Müll.  
*T. pachyphlebium* C. Chr.  
*T. pallidum* Bl.  
*T. palmatifidum* K. Müll.  
*T. palmicola* v. d. B.  
*T. palmifolium* Hayata.  
*T. paniculatum* v. A. v. R.  
*T. papillatum* K. Müller.  
*T. papuanum* Brause.  
  
*T. paradoxum* Domin.  
*T. parviflorum* Poir.  
*T. parvulum* Poir.  
*T. parvulum aliorum*.  
*T. parvum* Copel.  
*T. pedicellatum* Desv.  
*T. pellucens* Kze.  
*T. pennatum* Kaulf.  
*T. perpusillum* v. A. v. R.  
*T. pervenulosum* v. A. v. R.  
*T. Petersii* A. Gray.  
*T. philippianum* Sturm.  
*T. piliferum* v. A. v. R.  
*T. pilosum* Radlk.  
*T. pinnatifidum* v. d. B.  
*T. pinnatinerviolum* Jenman.  
*T. pinnatum* Hedwig.  
*T. platyrachis* Domin.  
*T. plicatum* Bedd.  
*T. Pluma* Hooker.  
*T. plumosum* Kze.  
*T. Poeppigii* Presl.  
*T. polyanthum* Hooker.  
*T. polyodon* Col.  
*T. polypodioides* L.  
*T. Powellii* Baker.  
*T. preclianum* Nakai.  
*T. procerum* Fée.  
*T. proliferum* Blume.  
*T. pseudo-arbuscula* v. A. v. R.  
*T. pseudocapillatum* v. A. v. R.  
*T. pulcherrimum* Copel.  
*T. pumilum* v. d. B.  
*T. punctatum* Christ.  
*T. punctatum* Poir.  
*T. pusillum* Sw.  
*T. pygmaeum* C. Chr.  
*T. pyxidiferum* L.  
*T. quelchertense* Nakai.  
  
*Feca osmundoides*.  
*Didymoglossum pabatianum*.  
*Davalliopsis* ?  
*Pleuronances pallidum*.  
*Microtrichomanes palmatifidum*.  
*Didymoglossum* sp.  
*Crepidomanes latemarginale*.  
 ? (*Crepidomanes* ?)  
*Selenodesmium obscurum*.  
*Microgonium*, *veris*. *M. sublimbatum*.  
*Didymoglossum* ?  
*Macroglena parviflora*.  
*Microtrichomanes parvulum*.  
*Gonocormus minutus*.  
*Vandenboschia parva*.  
 id.  
 id.  
*Trichomanes pinnatum*.  
*Crepidopteris* ?  
*Crepidomanes pervenulosum*.  
*Didymoglossum Petersii*.  
*Vandenboschia philippiana*.  
*Microtrichomanes* sp.  
 id.  
 id.  
*Didymoglossum* sp.  
 id.  
*Feca* sp.  
*Crepidomanes* sp.  
*Macroglena meifolia*.  
 id.  
*Trichomanes polypodioides* ?  
*Callistopteris polyantha*.  
*Selenodesmium elongatum*.  
 id.  
*Microtrichomanes vitiense*.  
*Nesopteris grandis*.  
 id.  
*Gonocormus protifer*.  
*Selenodesmium* ?  
*Crepidomanes* sp.  
*Vandenboschia aphleboides*.  
*Selenodesmium dentatum* ?  
*Crepidomanes bipunctatum*.  
*Didymoglossum punctatum*.  
*Didymoglossum pusillum*.  
*Crepidomanes* vel *Microgonium*.  
*Vandenboschia pyxidifera*.  
*Vandenboschia radicans*.

- T. racemulosum* v. d. B.  
*T. radicans* Sw.  
*T. recedens* Ros.  
*T. reniforme* Forster.  
*T. reptans* Sw.  
*T. rhizophyllum* Slosson.  
*T. rhomboidum* J. Sm.  
     (*C. rhomboidum* v. d. B. =  
*T. Ridleyi* Copel.  
*T. rigidum* Sw.  
*T. Robinsoni* Baker.  
*T. robustum* Fourn.  
*T. roemerianum* Ros.  
*T. rotundifolium* Jenman.  
*T. Rosenstockii* v. A. v. R.  
*T. Rotherii* v. A. v. R.  
*T. rotundifolium* Bonap.  
*T. rupestre* v. d. B.  
*T. rupicola* Rabenh.  
*T. savaiense* Lauterb.  
*T. saxatile* Moore.  
*T. saxifragoides* Presl.  
*T. Sayeri* F. Müller and Baker.  
*T. scandens* L.  
*T. Schlechteri* Brause.  
*T. schmidianum* Zenker.  
*T. schomburgkianum* Sturm.  
*T. Schultzii* Brause.  
*T. Seemannii* Carr.  
*T. sellowianum* Presl.  
*T. serratifolium* Ros.  
*T. serratum* Baker.  
*T. setaceum* v. d. B.  
*T. setiferum* Baker.  
*T. siamense* Christ.  
*T. sibthorpiioides* Bory.  
*T. singaporianum* v. A. v. R.  
*T. sinuatum* Bonap.  
*T. sociale* Lindb.  
*T. societense* J. W. Moore.  
*T. solitarium* Jeaman.  
*T. Somai* Nakai.  
*T. speciosum* Willd.  
*T. sphenoides* Kunze.  
*T. spinulosum* Phil.  
*T. stenosiphon* Christ.  
*T. strictum* Menzies.  
*T. stylosum* Pair.  
*T. subdeltoideum* C. Chr.  
*T. sublobatum* v. d. B.
- Selenodesmium obscurum*.  
*Vandenboschia radicans*.  
*Crepidomanes Christii*.  
*Cardiomanes reniforme*.  
*Didymoglossum reptans*.  
*Didymoglossum* sp.  
*Cephalomanes atrovirens*.  
*C. javanicum*.  
*Microtrichomanes Ridleyi*.  
*Selenodesmium rigidum*.  
*Didymoglossum Robinsonii*.  
     id.  
 ? (*Meringium* ?).  
     ?  
*Cephalomanes singaporianum*.  
*Crepidomanes Rotherii*.  
*Microgonium cuspidatum*.  
     id.  
*Crepidomanes rupicola*.  
*Pleuromanens pallidum*.  
*Selenodesmium obscurum*.  
*Gonacornus minutus*.  
*Microgonium* sp.  
*Vandenboschia scandens*.  
*Macroglena Schlechteri*.  
*Vandenboschia schmidiana*.  
*Trichomanes pinnatum*.  
*Macroglena* sp.  
*Selenodesmium dentatum*.  
     id.  
*Vandenboschia serratifolia*.  
*Meringium Lobtii*.  
*Macroglena setacea*.  
*Didymoglossum* sp.  
*Selenodesmium obscurum*.  
*Microtrichomanes purpureum*.  
*Cephalomanes singaporianum*.  
*Vandenboschia* sp.  
*Didymoglossum sociale*.  
*Callistopterix polyantha*.  
*Didymoglossum punctatum*.  
*Vandenboschia* sp.  
*Vandenboschia* sp.  
*Didymoglossum sphenoides*.  
*Leptocionium dicranotrichum*.  
*Vandenboschia stenosiphon*.  
*Macroglena stricta*.  
*Selenodesmium stylosum*.  
 ? (*Macroglena* ?).  
     id.

- T. sublimbatum* K. Müller.  
*T. subpinnatifidum* v. d. B.  
*T. subtilissimum* Brause.  
*T. subtrifidum* Matthew and Christ.  
*T. suffrutex* v. A. v. R.  
*T. sumatranum* v. A. v. R.  
*T. superbum* Backh.  
*T. taeniatum* Capel.  
*T. tamarisciforme* Jacq.  
*T. tanaicum* Hooker.  
*T. tenerum* Spr.  
*T. tenue* Brack.  
*T. tenuissimum* v. d. B.  
*T. tereticaulum* Ching.  
*T. Teysmannii* v. d. B.  
*T. thysanostomum* Mak.  
*T. Tosae* Christ.  
*T. trichophorum* v. A. v. R.  
*T. trichophyllum* Moore.  
*T. trigonum* Desv.  
*T. trinerve* Baker.  
*T. Trollii* Bergdolt.  
*T. Turekheintii* Christ.  
*T. Uffchelyi* Kümmerle.  
*T. Ulei* Christ.  
*T. varians* v. A. v. R.  
*T. Vaupelii* Brause.  
*T. venosum* R. Br.  
*T. venulosum* Capel.  
*T. vestitum* Baker.  
*T. Vieillardii* v. d. B.  
*T. virgatulum* v. d. B.  
*T. viridans* Mett.  
*T. vitense* Baker.  
*T. Vittaria* D. C.  
*T. Walleri* Watts.  
*T. Wallii* Thwaites.  
*T. Warburgii* Christ.  
*T. Wernerii* Ras.  
*T. Wildii* Bailey.
- Microgonium sublimbatum*.  
*Gonocormus minutus*.  
*Gonocormus* sp.  
*Gonocormus minutus*.  
*Cephalomanes* sp.  
*Cephalomanes sumatranum*.  
*Nesopteris superba*.  
*Microtrichomanes taeniatum*.  
*Selenodesmium* sp.  
 id.  
*Vandenboschia tenera*.  
*Crepidopteris andlicheriana*.  
*Vandenboschia* sp.  
*Selenodesmium tereticaulum*.  
*Gonocormus Teysmannii*.  
*Nesopteris thysanostoma*.  
*Crepidomanes Makinoi*.  
*Meringium* sp.  
*Macroplena setacea* ?  
 id.  
*Gonocormus* sp.  
*Peca Trollii*.  
 id.  
*Trichomanes polypodioides*.  
*Vandenboschia* sp.  
*Microgonium binaryinatum*.  
*Crepidopteris* sp.  
*Polyphlebium venosum*.  
*Crepidomanes venulosum*.  
*Meringium pachydermicum*.  
*Crepidopteris Vieillardii*.  
*Vandenboschia* sp.  
*Crepidomanes latimarginale*.  
*Microtrichomanes vitense*.  
 id.  
*Crepidomanes* ?  
*Didymoglossum Wallii*.  
*Selenodesmium* ?  
*Crepidopteris Wernerii*.  
*Vandenboschia* ?



## ILLUSTRATIONS

[The plates illustrate only those genera not illustrated in my treatises on *Trichomanes* and *Hymenophyllum*. The drawings are by Aliciusson.]

### PLATE 1

*Apteropteris Malingii* (Hooker) Copel., l. *Th. Ranft.* 1, Frond,  $\times 0.5$ ; 2, transverse section of segment,  $\times 235$ ; 3, sorus, laid open,  $\times 29$ ; 4, sporangium,  $\times 77$ .

### PLATE 2

*Bucsia Sodiroi* (C. Chr.) Copel., l. *Rimbach.* 1, Frond,  $\times 0.5$ ; 2, cells,  $\times 380$ ; 3, sorus,  $\times 14.5$ ; 4, receptacle,  $\times 14.5$ ; 5, sporangium,  $\times 77$ .

### PLATE 3

*Leptocarpum dicranotrichum* Presl, l. *Gundlch.* 1, Frond,  $\times 1.5$ ; 2, hairs,  $\times 77$ ; 3, cells,  $\times 380$ ; 4, sorus,  $\times 29$ ; 5, sporangium,  $\times 77$ .

### PLATE 4

*Scorpylopsis caespitosa* (Gaud.) C. Chr., l. *Capt. Dow*, ex U. S. Nat. Herb. 1, Plant,  $\times 1.5$ ; 2, cells,  $\times 380$ ; 3, trichome,  $\times 77$ ; 4, sorus,  $\times 29$ ; 5, sporangium,  $\times 77$ .

### PLATE 5

*Hymenoglossum cruciatum* (Cav.) Presl, l. p. *Claude Joseph*, ex Herb. Univ. Calif. 1, Frond,  $\times 0.5$ ; 2, cells, surface view,  $\times 380$ ; 3, transverse section of margin of frond,  $\times 235$ ; 4, sorus,  $\times 29$ ; 5, receptacle,  $\times 29$ ; 6, sporangium,  $\times 77$ .

### PLATE 6

*Cardamanca reniformis* (Forster) Presl, l. *Th. Ranft.* 1, Frond,  $\times 0.5$ ; 2, cells, surface view,  $\times 380$ ; 3, transverse section,  $\times 235$ ; 4, sorus,  $\times 29$ ; 5, sporangium,  $\times 77$ .

### PLATE 7

*Polyphlebium venosum* (R. Br.) Copel., l. *Th. Ranft.* 1 and 2, Frond,  $\times 1$ ; 3, cells,  $\times 380$ ; 4, sorus,  $\times 29$ ; 5, receptacle,  $\times 14.5$ ; 6, sporangium,  $\times 77$ .

### PLATE 8

*Trichomanes crispum* L., l. *Underwood*, in Jamaica. 1, Frond,  $\times 0.33$ ; 2, cells,  $\times 253.3$ ; 3, sorus,  $\times 19.3$ ; 4, sporangium,  $\times 51.3$ .

## PLATE 9

*Feca osmundoides* (DC.) Copel., l. *Tonduz*, in Costa Rica, ex Herb. Univ. Calif. 1, Frond,  $\times 0.5$ ; 2, cells,  $\times 235$ ; 3, sorus,  $\times 20$ ; 4, sporangium,  $\times 77$ .

## PLATE 10

*Lecanum membranaceum* (L.) Presl, l. *D. Watt*, in Jamaica. 1 and 2, Frond,  $\times 0.5$ ; 3, marginal scale,  $\times 38.5$ ; 4, cells, surface view,  $\times 380$ ; 5, transverse section,  $\times 235$ ; 6, sorus,  $\times 14.5$ ; 7, sporangium,  $\times 77$ .

## PLATE 11

*Davalliopsis elegans* (Rich.) Copel., l. *Bauer*, in Brazil (Bahia). 1, Frond,  $\times 0.33$ ; 2, cells, surface view,  $\times 253.3$ ; 3, transverse section,  $\times 156.6$ ; 4, sorus,  $\times 19.3$ ; 5, sporangium,  $\times 51.3$ .

## TEXT FIGURE

Diagram of affinities of genera.

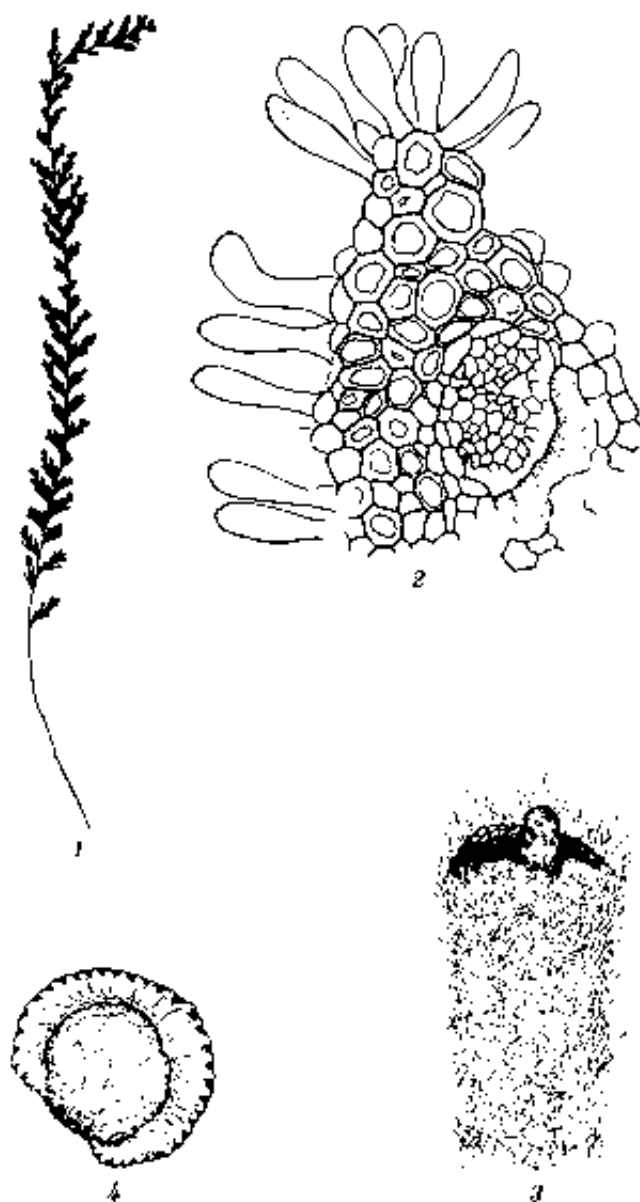


PLATE 1.

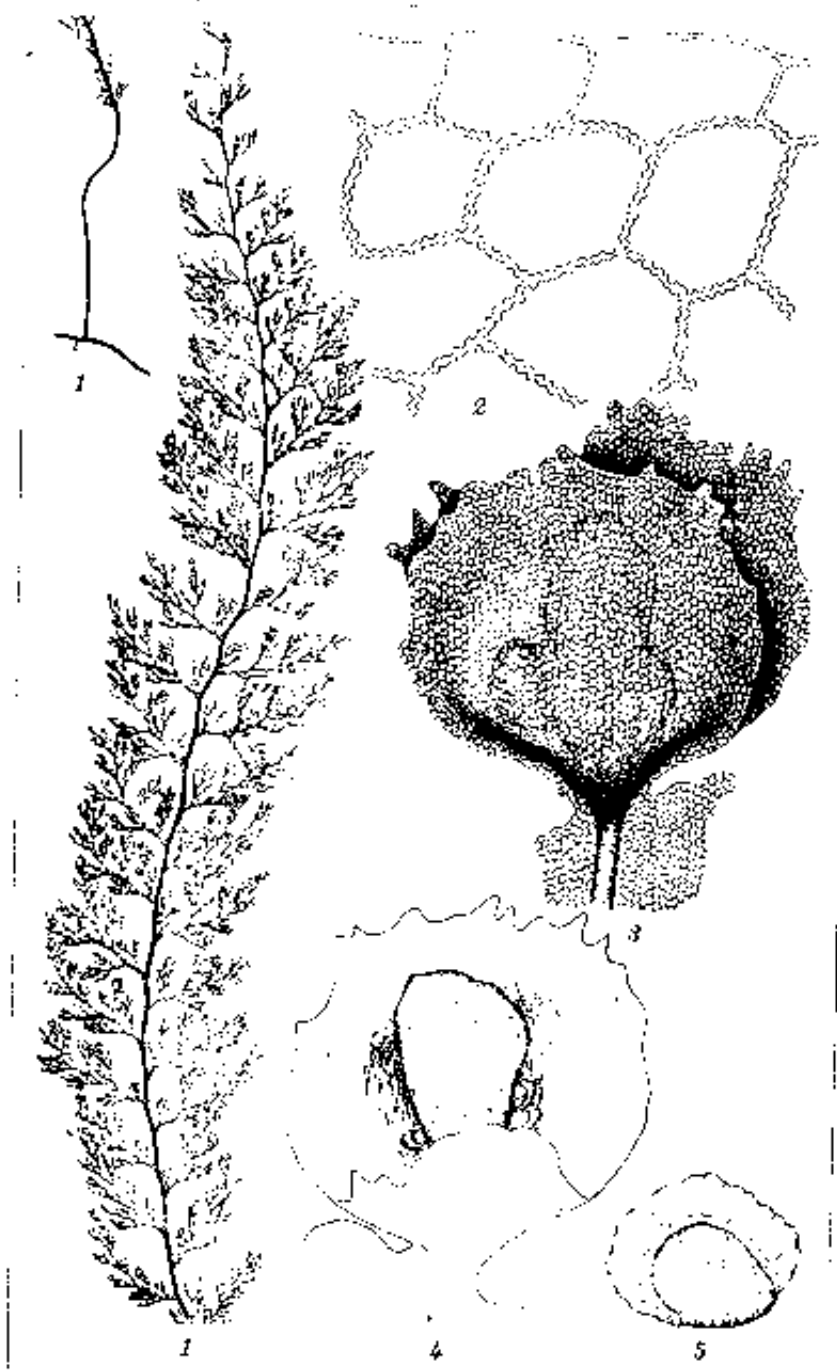


PLATE 2.

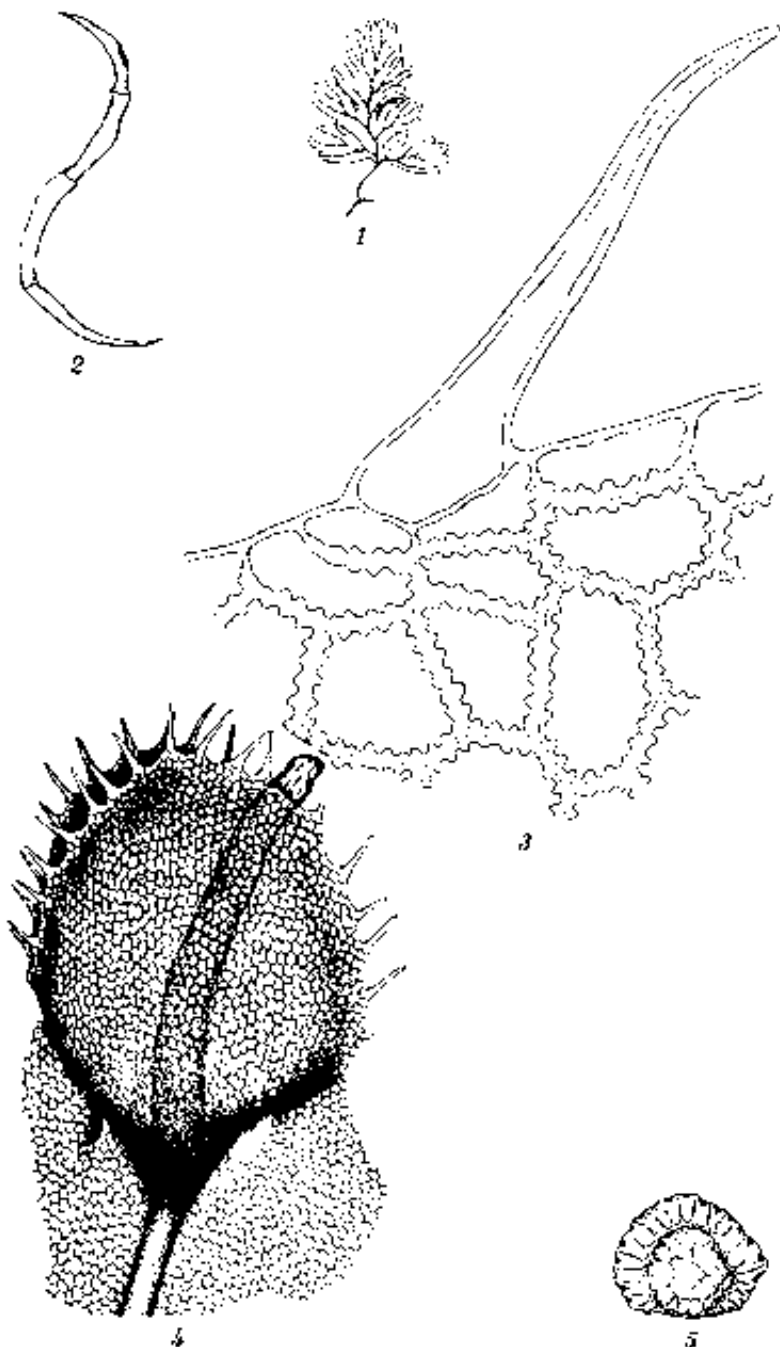


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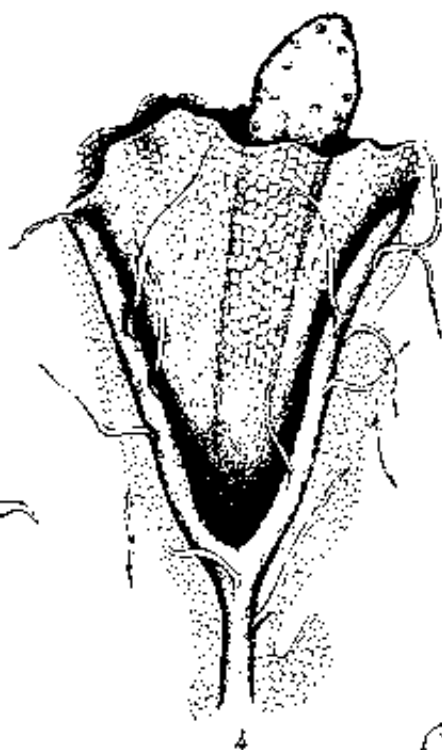
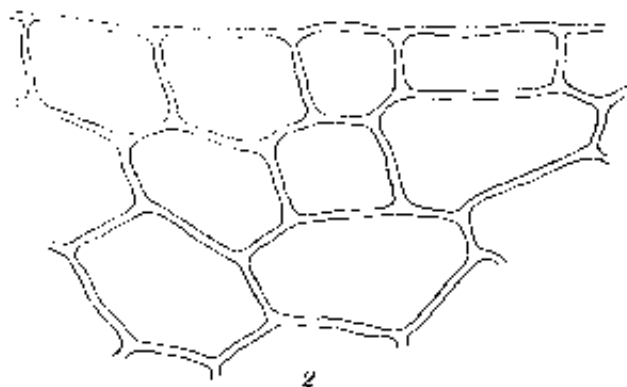
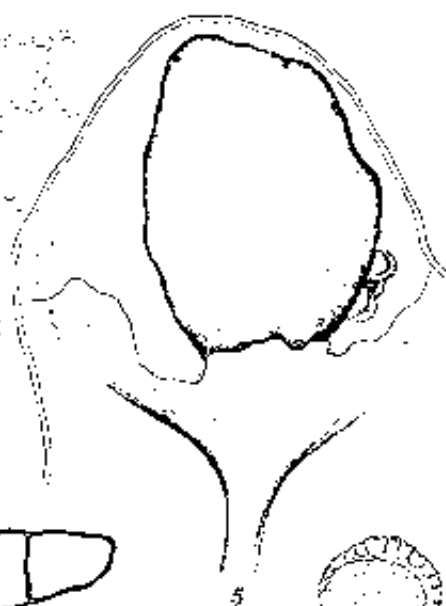
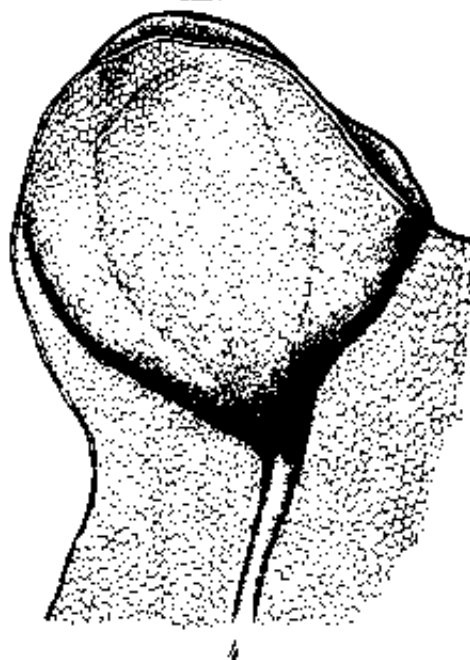


PLATE 4



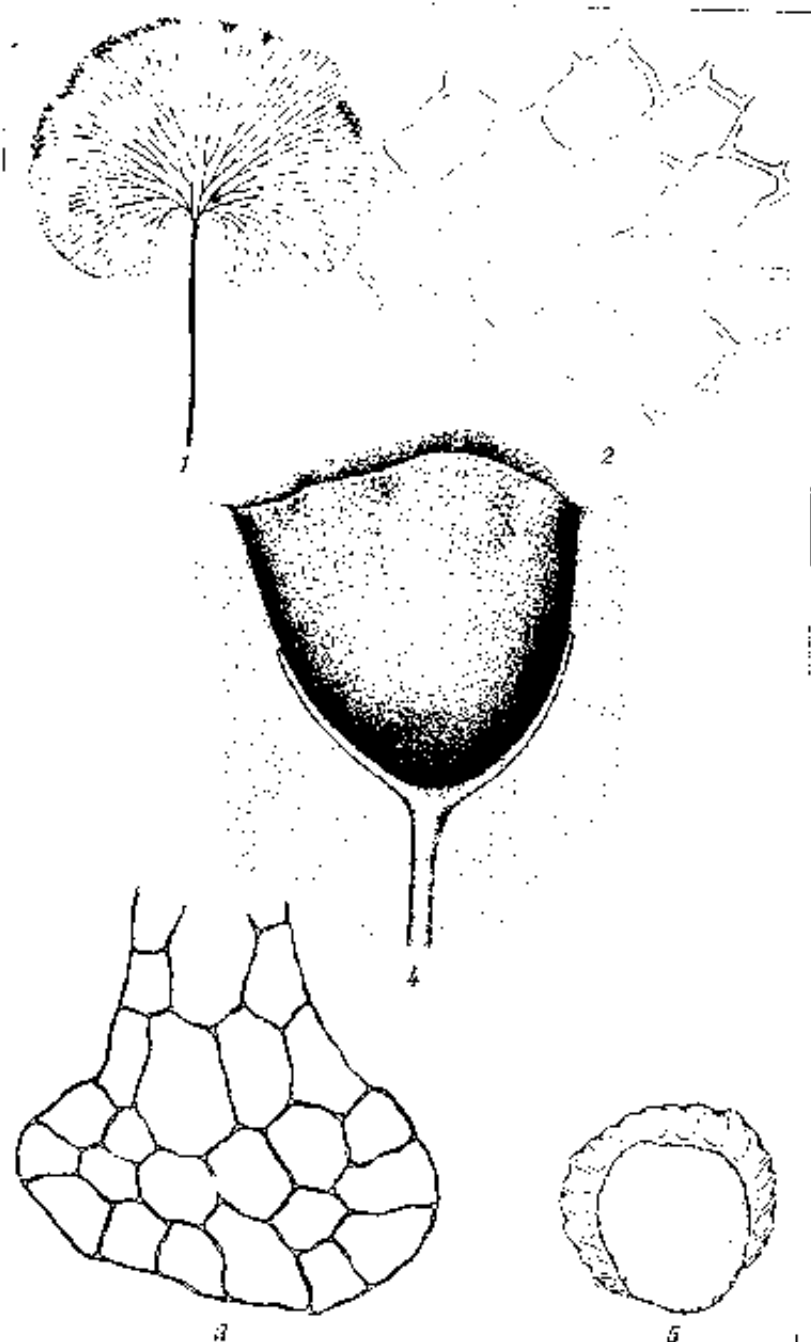


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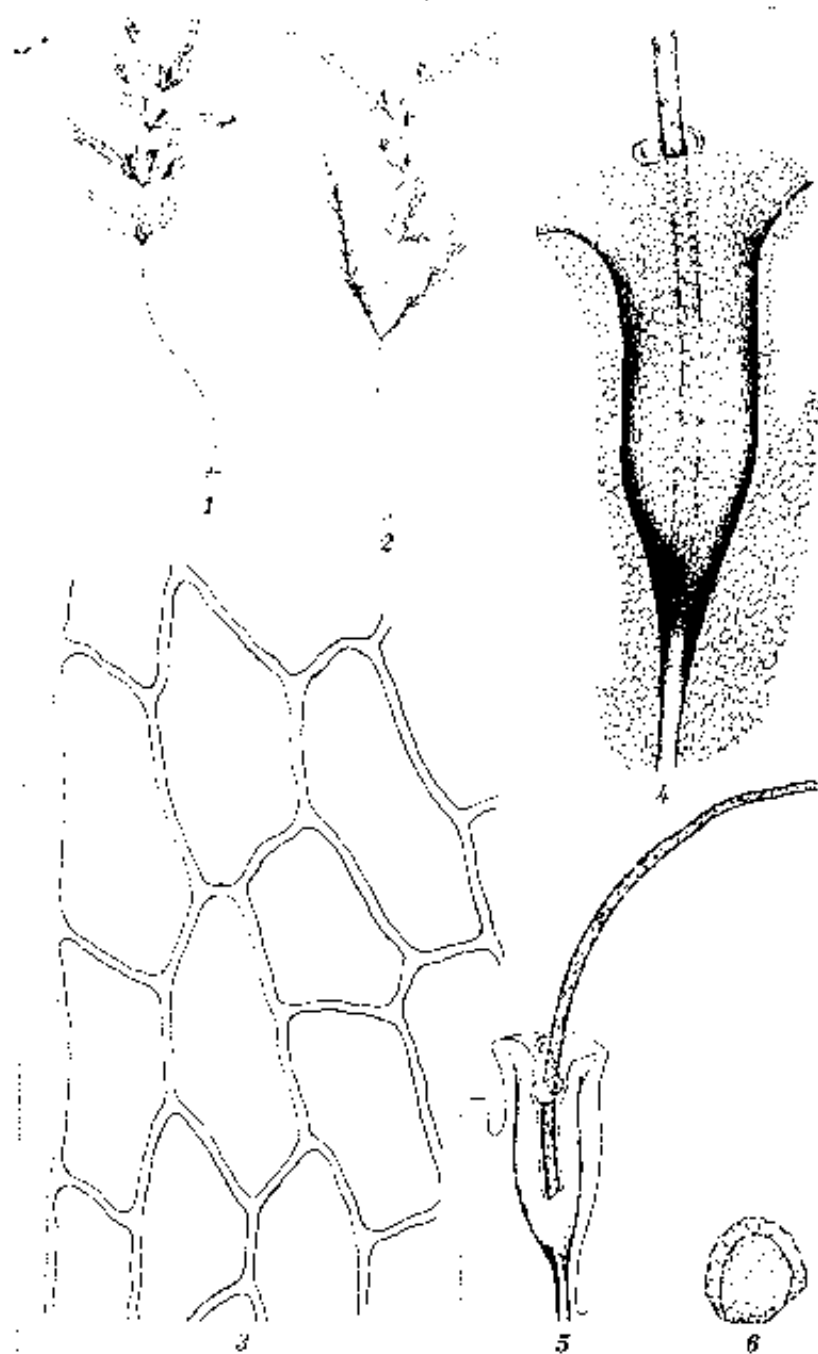


PLATE 7.

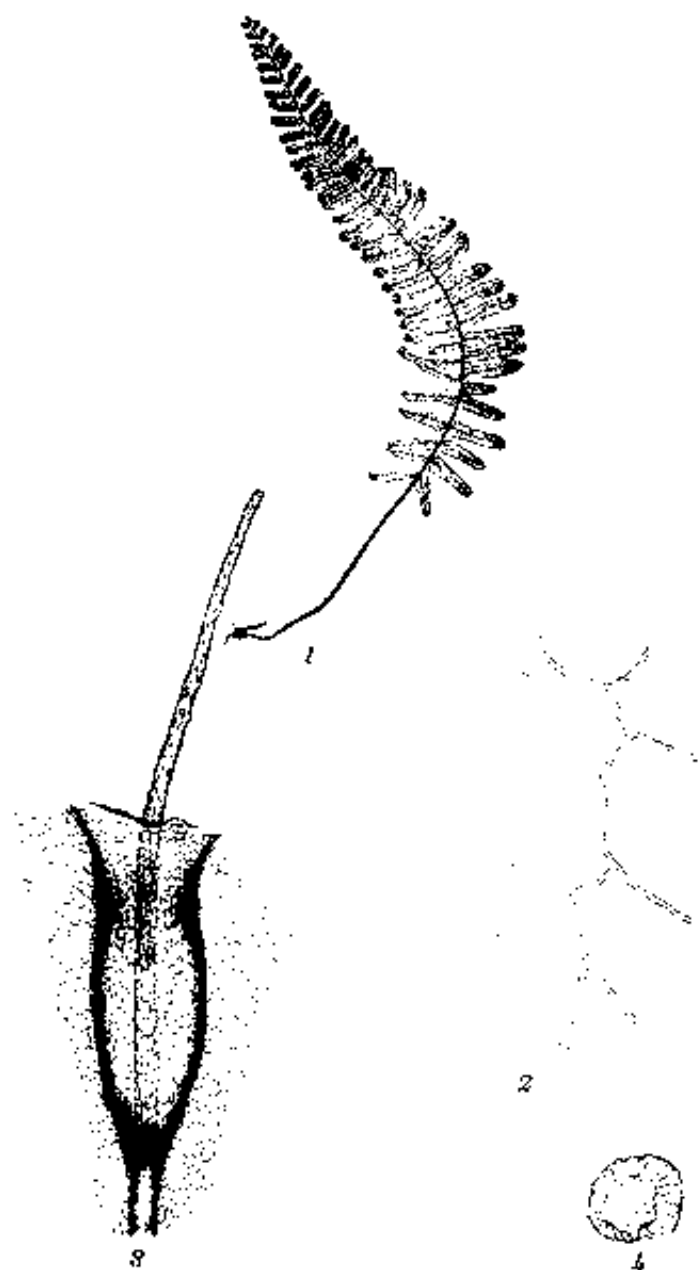
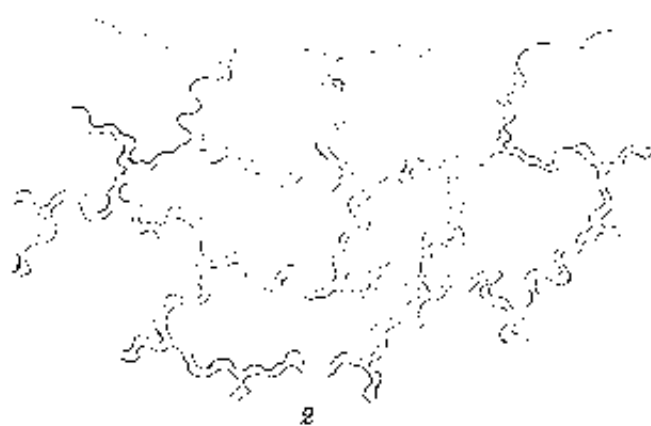


PLATE 2.



2



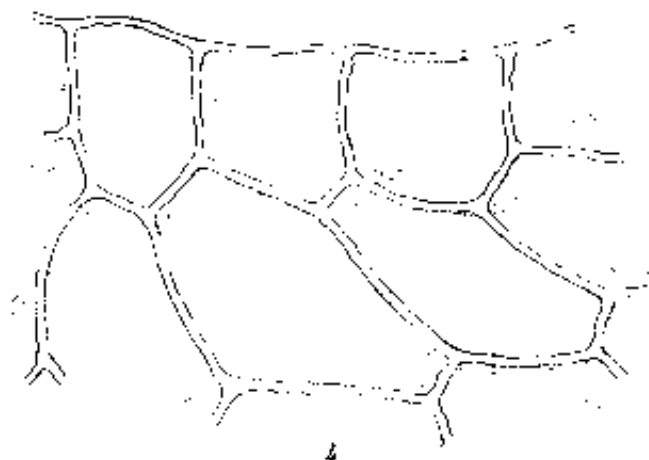
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3



4



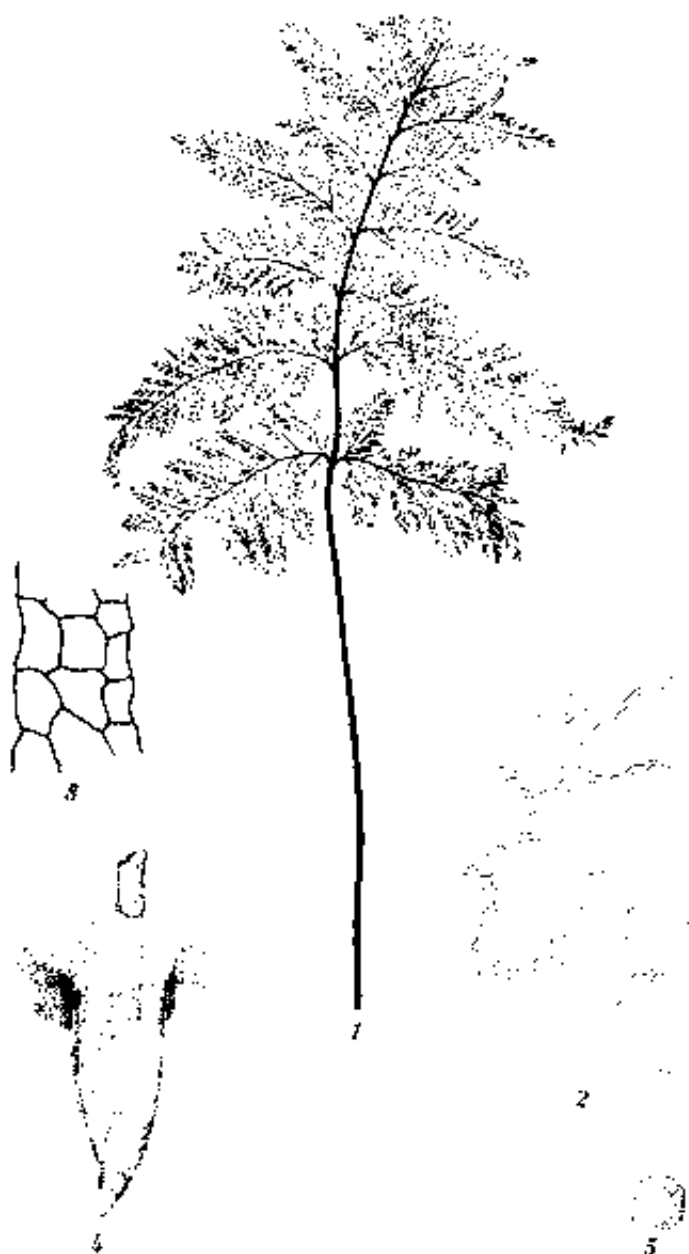


PLATE 11.